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A Magazine of Western Ornithology

Volume 47 November-December, 1945 Number 6

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THE CONDOR

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AMAUROSPIZA RELICTUS

Upper left, adult female; upper right, adult male; lower left, postjuvenal male; lower right, year-old male beginning first postnuptial molt. All approximately one-half natural size.

THE CONDOR

VOLUME 47 NOVEMBER-DECEMBER, 1945 NUMBER 6

CRITICAL COMMENTS ON SEED-EATERS OF THE GENUS AMAUROSPIZA

By ROBERT T. ORR and MILTON S. RAY

The genus *Amaurospiza*, described by Cabanis (1861:3), has for years remained one of the lesser known genera of the Fringillidae from Central and South America. This can be attributed largely to the rarity of specimens representing the known members of this genus in the various museums of the world.

Sharpe (1888:156-157) recognized the following three species, the last two of which he described as new: *Amaurospiza concolor* Cabanis, occurring in Costa Rica and Panamá, *A. aequatorialis* Sharpe inhabiting Ecuador, and *A. axillaris* Sharpe of Brazil. The latter was found by Hellmayr (1904:516-518) to be identical with *Sporophila* [= *Amaurospiza*] *moesta* Hartlaub (1853:36). Later Griscom (1934:414-415) separated *Amaurospiza concolor* into three geographic races, two of which he described for the first time, *A. c. grandior* from Nicaragua and *A. c. australis* occurring in Costa Rica and Panamá. The type locality of *A. c. concolor* was restricted to Miravalles in northwestern Costa Rica although the validity of this action has since been questioned (Hellmayr, 1938:238). Griscom (1934:412), also proposed a new genus and species, *Amaurospizopsis relictus*, based on a single specimen from Chilpancingo, Guerrero, Mexico, which in his opinion differed sufficiently from any of the known forms of *Amaurospiza* as to warrant such separation.

Hellmayr (1938:237-239) recognized two species of *Amaurospiza*: *A. concolor* and *A. moesta*. As regards the former species he tentatively admitted three geographic races: *A. c. grandior* (with some reservations), *A. c. concolor* and *A. c. aequatorialis*. *Amaurospiza c. australis* was considered indistinguishable from *A. c. concolor*. Concerning *Amaurospizopsis relictus*, Hellmayr (1934:237) states it "appears to be an exact duplicate of *Amaurospiza concolor* in coloration, but is slightly larger and has a somewhat differently shaped bill. In spite of these structural divergencies it may, however, prove to be merely a northern race of that bird, and more material is greatly needed to establish its true taxonomic position."

It was the receipt of five specimens of the so-called *Amaurospizopsis relictus* by one of us (Ray) that led to a study of this group, the results of which are presented here. This series was taken by the veteran collector Wilmot W. Brown near Chilpancingo where he had previously secured the type and heretofore unique specimen of this rare and little known bird on May 19, 1932. Included in our series is an adult male taken on May 27, 1940, two females taken on May 9 and May 20, 1940, and two immature males, one of the latter a bird of the year taken on August 11, 1939, the other seemingly one year old taken on July 11, 1939. The adult male was found to agree essentially with Griscom's (*op. cit.*) description of the type of *relictus*. For confirmation, however, this specimen was sent to the Museum of Comparative Zoology for direct comparison with the type. This comparison was made by Mr. James L. Peters and Mr. Ludlow Griscom,

both of whom agreed with our determination. The close similarity between adults of *Amaurospizopsis relictus* and an adult male and female of *Amaurospiza concolor* in the collection of the California Academy of Sciences induced us to follow this matter further. Accordingly, ten specimens of *Amaurospiza concolor*, representing all three of the Central American races recognized by Griscom (1934), were borrowed from the American Museum of Natural History. For the generous loan of these valuable specimens we wish to extend our sincere thanks to the officials of that institution.

After a careful comparison of *Amaurospizopsis* and *Amaurospiza* we feel that the differences are not sufficient to warrant a generic distinction. Mr. Griscom later concurred with us in this opinion and indicated (*fide* letter of November 1, 1944) that his views on avian genera, especially in the family Fringillidae, had undergone a radical change since he proposed the genus *Amaurospizopsis*.

Some of the characters ascribed to *Amaurospizopsis* are possessed equally well by members of the genus *Amaurospiza*. Both have a ridged culmen and a series of faintly indicated diagonal ridges and grooves extend forward from the nostrils on either side of the upper mandible. We do not consider the nostril to have a marked operculum in *Amaurospizopsis* as was asserted by Griscom, but rather to be surrounded above and behind by a membrane. It might also be mentioned that W. W. Brown commented in one of his letters that he failed to recall any distinct operculum in the type specimen of *Amaurospizopsis* when he collected it. The presence of this membrane was described as typical of *Amaurospiza* by Salvin and Godman (1885:350). Likewise, but little difference can be discerned in regard to the length of the rictal bristles which are described as being twice as long in *Amaurospizopsis*. The principal characters distinguishing the two genera relate to color and size. As these, in our opinion, are insufficient to warrant a generic separation, we propose, therefore, that *Amaurospizopsis* be regarded as a synonym of *Amaurospiza*. *Amaurospizopsis relictus* Griscom accordingly becomes *Amaurospiza relictus* (Griscom).

The specific status here accorded *Amaurospiza relictus* is purely tentative. Undoubtedly *relictus* bears a close relationship to *Amaurospiza concolor* but in view of the extensive geographical hiatus that exists between the known ranges of these two species and in the absence of any indication of intergradation shown by the specimens at our disposal we do not feel justified in reducing *relictus* to subspecific rank at present.

As may be seen from the data included in the table beyond, there is no overlapping between *A. relictus* and any of the Central American specimens of *A. concolor* examined in regard to length of wing and length of tail, *relictus* being decidedly larger in these respects. The wing and tail measurements of several specimens were omitted because of extremely worn condition of plumage. Although the measurement for length of bill is essentially the same for both species, this structure is considerably shorter in proportion to body size in *relictus*. In color the adult male of *relictus* is decidedly grayer and duller than are any of the adult males of races of *concolor* examined by us. The female of *Amaurospiza relictus*, heretofore unknown, is dull brown as was predicted by Griscom (1934:414) and as is true of other members of the genus *Amaurospiza* as well as several closely allied genera. Two specimens in moderately worn plumage, taken in May, are nearest Saccardo's Olive (Ridgway, 1912) on the back. It is highly probable that in fresh plumage they would most nearly approach Saccardo's Umber as does the immature male in fresh postjuvenal plumage. The latter specimen is Tawny Olive ventrally. The plumage of the females similarly is paler on the ventral parts.

Regarding the status of the several described races of *Amaurospiza concolor* from Central America, it may be seen from the table that the size differences are insignificant

Measurements of *Amaurospiza* in Millimeters

	Wing	Tail	Bill from nostril	Locality
Males				
A. c. "australis"				
C. A. S. 33414	63.0	53.0	6.7	Cerro de Punta, Chiriquí, Panamá
A. M. N. H. 515475	62.0	51.0	6.7	Boquete, Chiriquí, Panamá
A. M. N. H. 515474	molting		6.5	Boquete, Chiriquí, Panamá
A. c. "grandior"				
A. M. N. H. 102649	61.5	53.0	7.4	Tuma, Matagalpa, Nicaragua
A. M. N. H. 102650	64.0	53.3	7.5	Tuma, Matagalpa, Nicaragua
A. relictus				
Ad., Ray coll., P. M. O. 3334	70.2	63.0	7.5	Chilpancingo, Guerrero, Mexico
1st yr. bird, Ray coll., P. M. O. 3335	worn		7.3	Chilpancingo, Guerrero, Mexico
1st yr. bird, Ray coll., P. M. O. 3336	70.0	61.4	7.2	Chilpancingo, Guerrero, Mexico
Females				
A. c. concolor				
A. M. N. H. 515479	62.0	52.0	7.1	Miravalles, Costa Rica
A. M. N. H. 392909	61.5	49.0	7.3	Miravalles, Costa Rica
A. c. "australis"				
C. A. S. 33415	58.0	50.0	7.0	Cerro de Punta, Chiriquí, Panamá
A. M. N. H. 515477	61.0	48.0	7.1	Volcan, Chiriquí, Panamá
A. M. N. H. 515478	60.0	worn	7.1	Chiriquí, Panamá
A. c. "grandior"				
A. M. N. H. 103812	57.0	worn	7.2	Peña Blanca, Nicaragua
A. relictus				
Ad., Ray coll., P. M. O. 3337	68.1	58.3	6.9	Chilpancingo, Guerrero, Mexico
Ad., Ray coll., P. M. O. 3338		worn	7.2	Chilpancingo, Guerrero, Mexico

due to the considerable individual variation exhibited by members of this species. If only the measurements for the males of "*australis*" and "*grandior*" were available, one would suspect a racial differentiation in size because of the greater size of the two males from Nicaragua. The measurements for the females, however, do not bear this out and we have little reason to believe that there is any marked sexual dimorphism in this regard, although more extensive series might show the males to average slightly larger than females. While no males of *A. c. concolor* were examined, the differences between members of this race and *australis* were based upon color rather than size according to Griscom (*op. cit.*:415). That such color differences fall within the range of individual variation has already been pointed out by Hellmayr (*op. cit.*:238). No material representing *Amaurospiza c. aequatorialis* Sharpe has been examined by us, but judging from Hellmayr's description it is but a weakly defined South American race of *concolor*, characterized by slightly smaller size and somewhat paler coloration. Accordingly we propose that only two races of *Amaurospiza concolor* be recognized: *A. c. concolor* occurring in Central America and *A. c. aequatorialis* of northern South America, with the possibility that further collecting may ultimately show *Amaurospiza relictus* to be a large, pale, northern race of *concolor*.

So far as we know nothing has been written on the sequence of plumages and molts for any of the forms of *Amaurospiza*. Since several specimens in our series of *A. relictus* shed some light on this problem, we feel it worth while to include this information here. The brown postjuvenal plumage of the male, which has already been described, appears to be assumed late the first summer and maintained for one year. It is then lost as a result of the first complete annual molt and replaced by the blue gray plumage charac-

teristic of the adult male. This is indicated by one specimen, presumably a year old male, taken on July 1. Most of the plumage appears to be of the postjuvenal type and very worn. However, on the forehead, the sides of the head and on the chin new blue feathers, similar to those of the adult male, have made their appearance. There are several new blue feathers in the scapular region. One of the inner secondaries of either wing has been replaced by the adult type of feather as also has one of the greater coverts on the left wing. Further evidence regarding this molt in *Amaurospiza* is supplied by a specimen of *concolor* from Chiriquí, Panamá, no. 515474 in the collection of the American Museum of Natural History. Although the label bears no date, the bird obviously is in the process of completing the first annual molt. The new blue plumage is nearly complete except for the innermost secondaries which have not yet been replaced and are of the postjuvenal type. Likewise, several brown postjuvenal feathers are present on other parts of the body.

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California Academy of Sciences, and Pacific Museum of Ornithology, San Francisco, California, July 20, 1945.

PTERYLOGRAPHY, MOLT, AND AGE DETERMINATION OF AMERICAN JAYS OF THE GENUS APHELOCOMA

By FRANK A. PITELKA

The objectives of this paper are mainly to provide a basis for the study of plumages of jays of the genus *Aphelocoma* through detailed examination of pterylography, to determine the order of molt, and to ascertain, insofar as possible, the nature and extent of inter- and intra-specific differences in molt. In addition, the pterylographic data on *Aphelocoma* are offered as groundwork for comparative, phylogenetic studies of garruline genera. Although no extensive comparisons with other passerines are made, the available literature on order and extent of passerine molt has been consulted, and an attempt has been made to augment the usefulness of this paper to students of that general subject. Finally, results reported here are indispensable groundwork for revisionary studies of the genus; so far as accurate identification and description of races are concerned, basis is provided for distinguishing first-year from adult birds.

MATERIALS AND METHODS

For the study of pterylography, clipped alcoholic specimens of *Aphelocoma coerulescens insularis*, *A. c. oocleptica*, *A. c. superciliosa*, and *A. sordida arizonae* were used. No preserved specimens of *A. unicolor* were available. Of several thousand study skins of *Aphelocoma* which I have used in revisionary studies, 1910 taken during the period of molt or before the first complete molt provide the data on sequence, time, and extent of molt. Among the species and races of *Aphelocoma*, these are distributed as follows: *A. coerulescens coerulescens*, 63, *A. c. texana*, 32, *A. c. woodhouseii*, 156, *A. c. nevadae*, 229, *A. c. superciliosa*, 275, *A. c. californica*, 187, *A. c. oocleptica*, 144, *A. c. obscura*, 181, *A. c. cactophila*, 18, *A. c. hypoleuca*, 44, *A. c. insularis*, 75, *A. c. grisea*, 6, *A. c. cyanotis*, 43, *A. c. sumichrasti*, 12, and *A. c. remota*, 20; *A. unicolor*, 64; *A. sordida arizonae*, 153, *A. s. couchii*, 57, *A. s. colimae*, 32, *A. s. wollweberi*, 42, *A. s. sieberii*, 30, and *A. s. sordida*, 47. These have enabled me to determine molt sequence and periods more extensively than has been done, to my knowledge, for any other American group of closely related species. Comparisons of order and time of molt have been made by defining, for each species, a series of arbitrary molt stages; these are based on preliminary detailed examination of races represented by the largest number of individuals. Finally, two fledglings of *A. c. oocleptica*, obtained at Berkeley, California, in late May, 1945, were reared and examined periodically through the postjuvenal molt for the purposes of preparing a time schedule of that molt and of checking the time limits of arbitrarily defined stages.

For the geographic ranges of the species and races considered here, reference should be made to the A. O. U. Check-list (1931) and to Hellmayr (1934). Changes in the systematics of *Aphelocoma* subsequent to the publication of both these works and which are recognized here are reported by the A. O. U. Check-list Committee (1944:453, 1945:445) and Pitelka (1945:23). In addition, Ridgway's (1904:330) concept of the race *obscura* is adopted here; and Swarth's (1918:413) race *oocleptica* is restricted to the San Francisco Bay region, the coastal populations from Sonoma County northward being regarded as *californica* (Pitelka, MS).

PTERYLOGRAPHY

Detailed descriptions of the characteristic passerine arrangement of pterylae are available in the works of Nitzsch (1867), Boulton (1927), and Miller (1928, 1931).

For purposes of tentatively enumerating characteristics of corvid pterylography, the figures of *Aphelocoma* provided here should prove adequate. Detailed examinations revealed no differences between *A. coerulescens* and *A. sordida*; examination of study skins of *A. unicolor* did not reveal any differences between that species and the other two. Figures 35 and 36 are based on specimens of *A. c. insularis*.

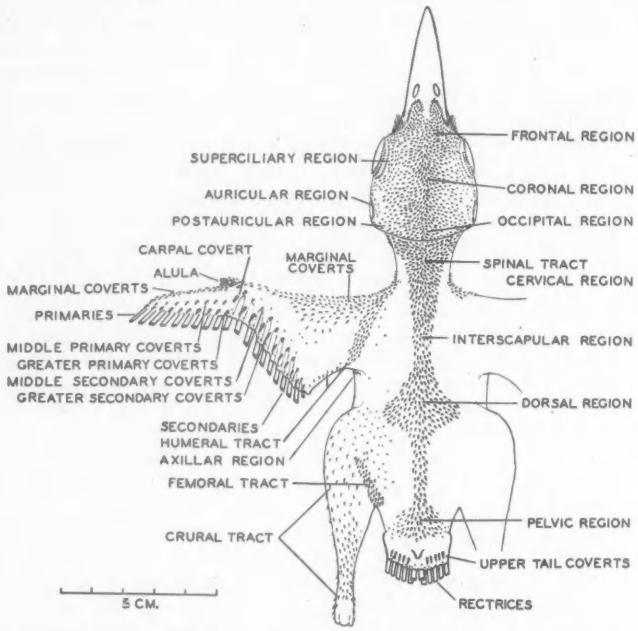

Fig. 35. Pterylography of *Aphelocoma coerulescens insularis*, dorsal view.

To my knowledge, there is no detailed account of corvid pterylography which might serve as a basis for evaluating the feather-tract pattern of *Aphelocoma*. It therefore seems appropriate to enumerate the distinctive features of *Aphelocoma* by comparing it with another comprehensively studied passerine, *Lanius* (Miller, 1931). The extent to which these features provide basis for generic differences among corvids must be left to future study. The alar tract is treated in greater detail than other tracts, and a few comparisons with *Troglodytes* (Boulton, 1927) are made.

Capital tract.—A frontal apterium (Miller, 1931:fig. 39) is lacking in *Aphelocoma*, although it is suggested by the median anterior indentation (fig. 35). The side of the head is more densely feathered than in *Lanius*, with a corresponding reduction in the definiteness of certain feather rows and apteria. There is no rictal apterium; the temporal apterium is present but is not distinctly outlined. The eye is surrounded by one complete circle of feathers as in *Lanius*, plus an incomplete outer circle. But one row of feathers encloses the ear opening along its posteroventral margin. The postauricular apterium is practically continuous with the lateral neck apterium.

Spinal tract.—The broadened dorsal and pelvic regions of the spinal tract are not so distinctly rhombic in outline as in *Lanius*.

Caudal tract.—There are ten fully developed upper tail coverts, those corresponding to the center pair of rectrices being reduced to small, soft feathers. The anal circlet is not a simple "circlet" in

Aphelocoma, being rather two groups of short, stiff feathers placed lateral to the anal opening and more or less enclosing the anus. The principal row of under tail coverts consists, again, of only ten feathers, those corresponding to the center pair of rectrices being absent.

Ventral tract.—The interramal region does not reach the posterior margin of the lower mandible.

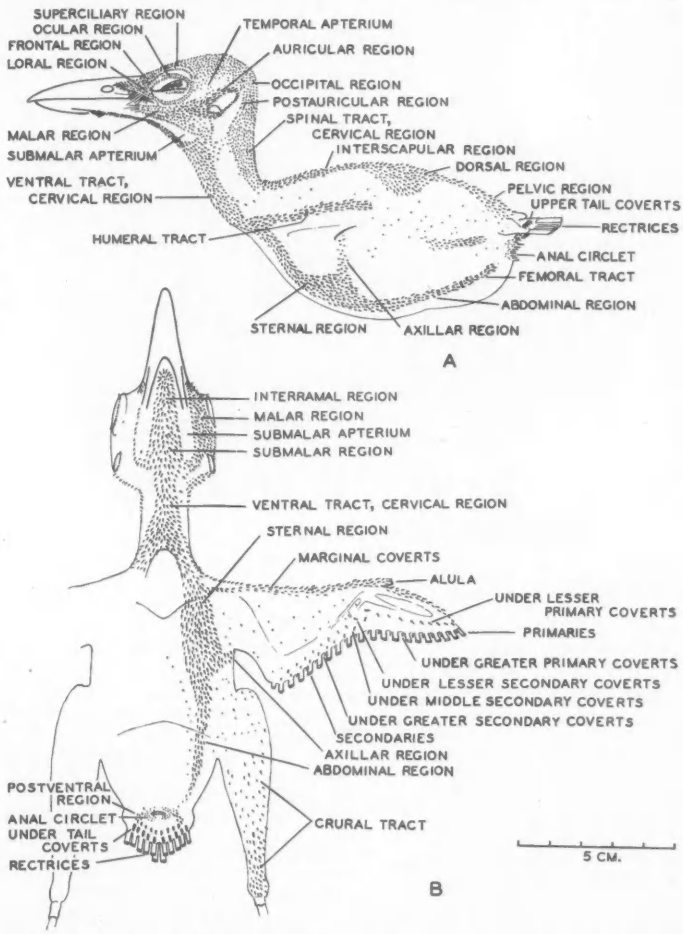

Fig. 36. Pterylography of *Aphelocoma coerulescens insularis*. A, lateral view; B, ventral view.

At the point of junction of the cervical region with the marginal coverts of the wing, there is a small, more or less triangular apterium. The sternal region is broader than in *Lanius* and is not divided posteriorly.

Alar tract.—The remiges total twenty (fig. 37). There is no evidence of a vestigial eleventh primary in *Aphelocoma*. The tenth secondary is short and, on the intact, folded wing, extends posteriorly eight or nine millimeters beyond the line formed by the posterior margin of the larger, distal greater secondary coverts. Actually it is smaller than most of these coverts (fig. 37). In all three species, the

tenth secondary differs from the coverts with which it might be confused by being slightly duller than the coverts; moreover, proximally, the greater coverts become smaller as do the secondaries, and the tenth covert is only about one-half the size of the larger, distal coverts. In *Lanius,* a vestigial tenth secondary occurs and corresponds to the tenth greater covert to be seen in the figure prepared by Miller (1931:127). Secondaries of corvids are of eutaxic arrangement; so far as known, this is true of all passerines (W. DeW. Miller, 1924:312).

Aphelocoma possesses ten greater upper primary coverts and nine middle upper primary coverts, the first (proximal) one being absent. The covert of the so-called "carpal remex" lies at the base of the first primary (Boulton, 1927:396) and is in the approximate position of the first middle primary covert (as also in *Lanius*; see Miller, 1931:fig. 39). Lesser upper primary coverts are lacking. Each of

Fig. 37. Dorsal view of left wing of *Aphelocoma coerulescens oocleptica.* Note: twenty remiges; covert of carpal remex separating series of greater primary coverts, of which only eight are evident, from greater secondary coverts; alula, middle secondary coverts, and marginals.

the ten greater upper secondary coverts is inserted at the base of and slightly proximal to the corresponding secondary. There are nine middle upper secondary coverts which, in their insertion, alternate with the greater coverts. Possibly the distalmost feather of this series, placed between the covert of the carpal remex and the first greater secondary covert, is the tenth. Distal to the latter feather is another small covert of comparable form lying posterior and medial to the innermost of the three feathers of the alula. It is not possible to distinguish lesser secondary coverts. The alular coverts form the distal terminus of the middle secondary covert series; all other feathers along the base of the alula are not distinguishable from coverts along the anterior margin.

Like *Troglodytes* (Boulton, 1927:397), *Aphelocoma* lacks middle under primary coverts. The greater under primary coverts number ten, lesser coverts nine (numbers 2-10). But the position of the first lesser covert is occupied by an outwardly directed lesser covert which represents the distal tip of the secondary series of these feathers (fig. 38). Excluding the lesser covert just mentioned, those of the under wing secondary series number nine. What appears to be a series of middle under secondary coverts consists of ten feathers in the larger *Aphelocoma c. insularis,* nine in *A. c. superciliosa* from western Stanislaus County and *A. c. oocleptica* from Alameda County, California. The distalmost of these is apparently the feather which Boulton (1927:397) identifies as the "under carpal remex covert." If, as appears to be the case, this is a feather of the series of under wing middle secondary coverts, then its correspondence to the upper covert of the carpal remex is doubtful. The suggestion that the two main series of under wing secondary coverts are lesser and middle coverts is supported by the fact that the series of greater under primary coverts continues medially, the feathers in the secondary series being considerably reduced and numbering only seven (fig. 38); those of secondaries 8, 9, and 10 are absent. In arrangement of under wing covert series, *Aphelocoma* resembles *Lanius*; however, the

series here regarded as under lesser primary coverts is termed by Miller (1931:125) under middle coverts, and under lesser and middle secondary coverts of this paper are there termed under middle and greater coverts, respectively. Although present at at least distally in *Lanius*, under greater secondary coverts of this paper are not indicated in Miller's figures (*loc. cit.*), in which the position of much reduced under greater coverts is taken by stubs of the large-sized dorsal greater secondary coverts.

As in *Lanius* (Miller, 1928:396), a series of vestigial tertiaries numbering five or six is present along the posterior, distal humeral margin. The proximalmost of these are not distinguishable from the feathers of the humeral tract proper; the distalmost has the form of a proximal greater secondary covert.

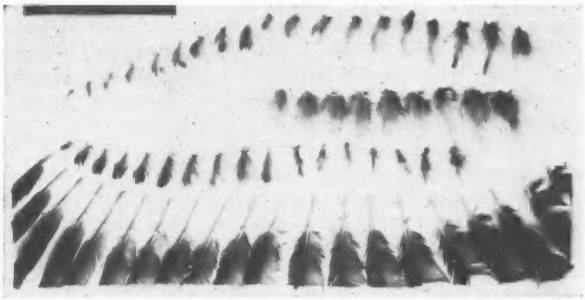

Fig. 38. Under wing coverts and remiges from the right wing of *Aphelocoma coerulescens superciliosa*, arranged to show principal series: lesser and greater primary coverts; lesser, middle, and the incomplete series of "greater" secondary coverts.

At the bases of the first primary and all secondaries except the tenth are downy feathers which remain when all remiges and coverts are removed from the forearm. A similar series of five or six feathers occurs at the base of the greater secondary coverts in the midregion of the series.

Comparisons of Aphelocoma with other corvids.—Nitzsch (1867:75) based his descriptions of pterylography in the "Corvinae" on *Corvus juliginosus* [?= *Psilorhinus morio*], *C. azureus* [= *Cyanocorax caeruleus*], *C. pica* [= *Pica pica*], *C. vagabundus* [= *Dendrocitta rufa*], *Glaucopis leucoptera* [= *Platysmurus leucopterus*], and *Glaucopis varians* [= *Crypsirina varians*]. Nitzsch included in this group *Glaucopis* [= *Callaeas*] *cinerea*, one of several "crows" of the Australian region which are probably more closely related to the Sturnidae than to the Corvidae (Stonor, 1942:9). These species are said to have the saddle of the spinal tract (= dorsal region) laterally acute-angled, enclosing an elongated, fissure-like space. *Aphelocoma* differs in that the saddle is not acute-angled; this, however, is not a surprising difference and may be one separating genera. But variation among corvids in this respect is probably more extensive than suggested by the departure of *Aphelocoma*, as in *Corvus*, the dilatation of the spinal tract is only slight and definitely not acute-angled. *Aphelocoma* differs also in the absence of a fissure-like space in the dorsal region. This departure of *Aphelocoma* is a more intriguing one, as it is an example of the type of difference existing between major passerine groups, let alone related genera. The apterium is absent in *Cyanocitta*, and in *Kitta* [= *Cissa*], which last is listed by Nitzsch (1867:76) under the Paradisidae and is figured by him. But in *Corvus*, a middorsal apterium as described by him is present. It is not possible to determine with certainty the presence or absence of this apterium from study skins, and Nitzsch's contention with respect to *Cyanocorax*, perhaps the closest relative of *Aphelocoma* among the genera mentioned by him, can be confirmed or rejected only

by examination of preserved specimens. At any rate, here is an intrafamilial difference whose significance along with others mentioned in this account needs to be established by comparative study of corvid genera. At this time, it is possible only to say that among Palearctic as well as Nearctic jays a middorsal apterium may or may not occur; it does not occur in *Aphelocoma* and *Cyanocitta*.

Nitzsch further stated that in the "Corvinae," the dilatation of the pectoral band is separated from the main stem for a considerable distance. Figure 36 shows this not to be the case in *Aphelocoma*, in which the dilatation is broad, but obtuse-angled posteriorly, with a lateral branch under and behind the wing. The validity of Nitzsch's statements can, of course, be established by study of preserved specimens of the forms he mentions. Some misidentifications, however, may be involved. "*Corvus juliginosus*" is not listed by Sharp (1877) nor Ridgway (1904), although both of these authorities list "*Pica juliginosa*" as a synonym of *Psilorhinus morio*. Meinertzhagen (1926:113) does not list *juliginosus* among names applied to the genus *Corvus*.

According to Nitzsch (1867:75), the "Corvinae" possess "nineteen, and in rare instances twenty remiges, of which ten are on the hand." In one instance, *Platysmurus*, Nitzsch found only eighteen remiges (and only ten rectrices). Among American jays, twenty is apparently the characteristic number of remiges. I have examined study skins of all genera except *Uroleuca*. Among Palearctic genera, some of which occur also in North America, twenty remiges have been found in specimens of *Corvus, Cissa, Urocissa, Dendrocitta, Pica,* and *Nucifraga; Platysmurus,* Nitzsch notwithstanding, and *Perisoreus, Garrulus,* and *Cyanopica* appear to have nineteen, but if the tenth secondary is markedly reduced, its presence in these forms cannot be determined safely from study skins. At any rate, it is evident that twenty remiges are a common and probably characteristic number among corvids.

POSTJUVENAL MOLT

As reported for corvids in general by Dwight (1900:152), the postjuvenal or first fall molt is always partial. All body feathers are replaced; rectrices are retained; most and usually all of the remiges are retained; but the degree of replacement of wing coverts is highly variable. Some of Dwight's generalizations with respect to wing molt are incorrect. In *Corvus,* for instance, the postjuvenal molt does not always involve all wing coverts; Witherby (1913:135) describes this molt more correctly, if a generalization is to be made, when he states that it does not involve, in *Corvus frugilegus,* "the remiges, bastard-wing, [greater] primary coverts, majority of greater [secondary] coverts . . . and rectrices." (See also Emlen, 1936:100.) Likewise, in *Aphelocoma*, in general, the feathers of the alula, greater primary coverts, a variable number of greater secondary coverts, remiges, and rectrices are retained through the postjuvenal molt. There are, however, notable exceptions involving significant interspecific as well as intraspecific differences, chiefly in molt of wing coverts.

Inception of molt.—Examination of juvenal specimens of *Aphelocoma* might at first cause one to suspect early inception of the postjuvenal molt for two reasons. First, near the time of departure from the nest and for a period of two or three weeks afterward, active growth of marginal feathers of the wing occurs; new marginals may be seen to be breaking sheaths even after departure from the nest. But these marginals are blue, not dull bluish brown, the color of the juvenal middle secondary coverts and the distalmost marginals. Whether this growth follows a limited molt or not cannot be said at this time; it is necessary to observe developing nestlings to settle the point. But the growth stages observed on study skins and on living birds obtained at the time of departure from the nest would indicate that these coverts represent part of the develop-

ing juvenal plumage whose emergence has been delayed until the growth of the arm has declined and until the patagial membrane is grown. At this time the downy, small brown feathers of the arm margin are overlain and possibly replaced by the blue coverts. All the marginal coverts are subsequently replaced. Thus, whether an abbreviated molt occurs at the time of departure from the nest or not, the fact remains that growth of marginals is then active on the anterior portion of the dorsal patagial surface, which is otherwise naked. Subsequently, new supramarginals emerge posteriorly and medially.

The second reason for suspecting early inception of molt concerns the occurrence of blue feathers on areas normally brown before the postjuvenal molt. In the juvenal plumage, the greater coverts, remiges, and rectrices are of a blue approaching that of the adult plumage; all other dark areas are gray-brown. If, at the time the blue marginal coverts emerge, any juvenal feathers of the areas to become blue in subsequent molts are lost, they, too, are replaced by blue feathers. Thus, scattered blue feathers on head,

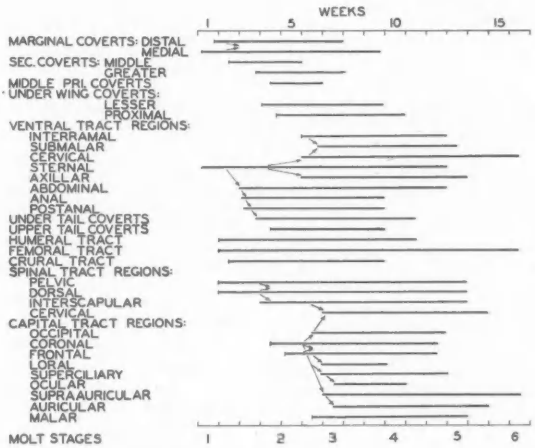

Fig. 39. Time chart of the postjuvenal molt of two caged individuals of *Aphelocoma coerulescens oocleptica*. Order of inception of molt at different loci shown by relative position of those black lines which begin at the left with a short vertical line. Spread of molt to other parts of the body shown by small arrows. Time scale shown along top margin; relation of molt stages defined in table 1 to molt of caged birds shown along bottom margin.

neck, or collar areas occur occasionally which are suggestive of the postjuvenal molt, but which actually represent adventitious replacement. At any rate, these observations are evidence of a significant step in developmental physiology: The mechanism of pigment deposition is altered so that blue coloration appears in body feathers developed well before the beginning of the postjuvenal molt.

At the time of departure from the nest, under wing coverts are still lacking. They emerge within the first week afterward and complete their growth in two to three weeks. In spite of the delay in their appearance, some replacement, at least, occurs during the postjuvenal molt (fig. 39).

Subsequent to events described above, there is no evidence of feather loss or growth for a period of two to three weeks. In the case of two jays which left a nest at Berkeley on May 10 and 11, 1945, respectively, loss of feathers marking the beginning of the postjuvenal molt occurred on June 15. Thus, the postjuvenal molt began about five weeks after departure from the nest.

Molt stages.—In spite of individual variation, the order of feather replacement is generally consistent. Examination of large series of study skins of Californian races of *A. coerulescens* has enabled me to define six arbitrary stages (table 1) in terms of

Table 1

Arbitrary Stages of the Postjuvenal Molt in *Aphelocoma coerulescens*

Ventral tract	Alar tract	Capital tract, dorsally	Capital tract, laterally	Spinal tract	Tail coverts
1[1] Feathers of sternal region breaking sheaths	Marginal feathers partially grown				
2 Sternal region refeathered[2]; molt progressing anteriorly and posteriorly	Middle sec. cov. well grown; gr. sec. cov. breaking sheaths	Partially refeathered	Feathers breaking sheaths on malar region	Scattered new feathers evident	Breaking sheaths
3 Middle of throat refeathered; old feathers on sides of throat and neck	Gr. sec. cov. about half grown	More than half refeathered	Feathers breaking sheaths also on auricular area; old feathers on sides of head	Patchwork of new and old feathers	Partially grown; some old feathers still present
4 Some juvenal feathers on abdomen; those of lower throat partially grown	Gr. sec. cov. well grown	Refeathered	Old and partially grown new feathers mixed	A few scattered juvenal feathers	Well grown
5 Growth of ventral tract incomplete	Fully grown	Scattered feathers of lateral occipital region not fully grown	Active growth of new feathers	Scattered feathers incompletely grown	Growth complete
6 Scattered feathers of interramal and lateral throat areas partially grown.		Growth complete	Few feathers partially grown	Growth complete	

[1] Stage number.
[2] New feathers predominant superficially and well grown, but sheathed basally.

which molt can be timed and compared between different geographic areas. As defined in table 1, these stages are applicable to all western North American races of *A. coerulescens*; too few specimens were available to test their applicability to Floridan and Mexican races. In table 1, and similar ones beyond, no attempt is made to include more than key evidences of molt. It may be added that throughout this study each specimen undergoing molt was judged in terms of the series of characters given for each stage. Although but six stages are defined for the postjuvenal molt, the assignment of combined numbers, as "2-3" to indicate intermediacy, increased the usable number of molt stages to 11. The data obtained by this method were compiled by plotting the molt stages of individual specimens against time (fig. 40).

Period of molt.—Within the range of *A. c. oocleptica*, the time during which individual birds at any given stage of molt may be found totals about two months. This is shown in figure 40B, which represents the combined data for *oocleptica* and south-coast *californica* between which no difference in molt was evident. (By south-coast *californica* is meant the coastal population from Santa Barbara County northward to the San Francisco Bay region where *oocleptica* occurs.)

It may be estimated from figure 40B that the postjuvenal molt occupies a period

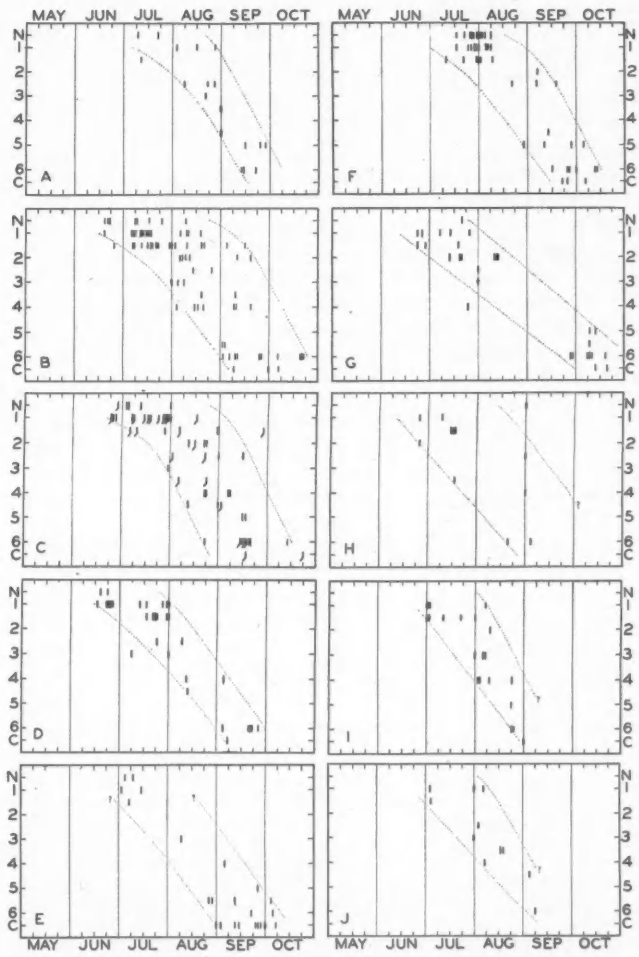

Fig. 40. Period of the postjuvenal molt in different races of *Aphelocoma coerulescens* in western North America. Molt stages are described in table 1; N, no signs of molt; C, molt completed. A, north-coast *californica* (Sonoma and Napa counties north to Del Norte and Curry counties); B, *oocleptica* (San Francisco Bay region) and south-coast *californica* (Santa Barbara County north to San Mateo and Santa Clara counties); C, *obscura* (northern Lower California north to Los Angeles County), each female indicated by a small hook at lower end of vertical line; D, northern *nevadae* (western Utah, Nevada, eastern California); E, southern *nevadae* (southeastern California, Arizona); F, northern *superciliosa* (south-central Oregon, northern California); G, southern *superciliosa* (San Joaquin Valley, adjoining foothills, east slopes of southern Sierra Nevada); H, *insularis*; I, northern *woodhouseii* (Colorado, eastern Utah); J, southern *woodhouseii* (New Mexico, extreme western Texas).

of two and one-half months. This period is shorter than that obtained by observations of two caged birds obtained at the time of departure from the nest. In these the total time was approximately fifteen weeks, or slightly more than three months. The difference is probably to be explained in part at least by the fact that the caged birds suffered irregular loss of scattered remiges or rectrices during the course of the postjuvenal molt; their replacement may have slowed down the whole process. In other respects, however, the molt of the caged birds appeared normal and followed closely the sequence stablished by study of skins. Part of the data obtained from the study of the caged birds is condensed into figure 39, which serves to show the period during which replacement occurs in the main pterylae and the order in which molt begins at different, spatially independent points (see beyond). In figure 39, numbers for the stages of the postjuvenal molt are placed in as nearly correct position as possible in relation to the criteria of the individual stages, as given in table 6, and to the chronological evidence provided by the study of caged birds. It would appear that the six arbitrarily defined stages represent more or less equivalent time periods and that the major discrepancies between table 6 and this chart are due to the protraction of the molt process in the caged birds.

Although the plotting of the postjuvenal molt period for *oocleptica* and other populations initially involved separation of males and females, no difference was found between them. Thus, in figure 40, all graphs are based on combined data from the two sexes; in one, however, that for the race *obscura* (C), sex of the individual specimens is shown.

Molt loci.—Molt begins at a number of different points or loci and spreads from them in a characteristic manner. Inception of molt at these loci is independent of other loci in space, but not in time. The order of activation of these loci in Californian races of *A. coerulescens* is shown in figure 39. Most molt loci in *Aphelocoma*, and this is probably true in passerines generally, are characteristic of all individuals of a particular population or race and, with some exceptions noted below, of the species. From any given locus, molt progresses linearly (that is, in the main axis of the tract) more rapidly than it does laterally. Evidence of asymmetry in progress as well as extent of the postjuvenal molt is negligible and not significant. The following molt loci, based on evidence from study skins as well as from living birds, are recognized for *A. coerulescens*:

(1) Sternal region (see fig. 36).—Molt progresses from here anteriorly and posteriorly, but this progress is not comparable in rate in both directions: Posteriorly, new growth appears along the length of the ventral tract within two weeks of inception of molt on the sternal region. Replacement of the under tail coverts occurs after molt has progressed along the ventral tract to the anal and postanal areas and begins about two and one-half weeks after that of the sternal region. Anteriorly, replacement progresses slowly for about four weeks; when it is accelerated, simultaneously growth begins at locus 2.

(2) Interramal region.—Growth progresses posteriorly, and within a week replacement along the throat is continuous.

(3) Medial marginal coverts.—Molt begins near the outer margin of the dorsal patagial surface usually at the same time as that of the sternal region, or a few days before the latter. Replacement proceeds medially and distally, but most rapidly posteriorly; it does not proceed ventrally along the anterior margin of the patagium. Subsequently a junction takes place between growth from this locus and that from a more distal one, locus 4.

(4) Distal marginal coverts.—Molt begins on the anteroventral margin of the metacarpal segment and proceeds first distally and dorsally and later proximally. Progress of molt from this locus is slowest proximally. The under wing marginal coverts, except the most proximal ones, are replaced in the course of molt issuing from either locus 3 or locus 4.

(5) Proximal under wing marginal coverts.—Replacement begins on the ventral patagial surface about three weeks after that of marginals at locus 4 has begun. From locus 5, molt spreads over the under wing area and, after slightly more than a week, it proceeds anteriorly and distally toward the alula, where active growth is in progress.

(6) Humeral tract. (7) Femoral tract.—Replacement begins in the mid-regions of these two tracts at approximately the same time and proceeds anteriorly and posteriorly.

(8) Proximal crural tract. (9) Distal crural tract.—Two loci are evident on the crural tract: a proximal one on the anterior face of the crus, and a distal one at the tarsal joint. Molt at the proximal center may begin before that of the distal one; or it may begin at both more or less simultaneously. Growth proceeds distally and proximally, but most rapidly distally. The last feathers to be replaced are those on the proximomedial surface of the shank.

(10) Middle secondary coverts.—Replacement of the middle secondary coverts begins soon after that of the marginals. There is considerable irregularity in this replacement; molt may proceed distally or proximally, or in both directions. In most instances, the majority of the coverts emerge more or less simultaneously.

(11) Greater secondary coverts.—When the middle secondary coverts are almost fully grown, or approximately ten days after their emergence, replacement of the greater secondary coverts begins. It is more regular than that of the middle coverts. Two loci are recognizable, a distal one and a proximal one, usually at covert 8, from which molt proceeds to 7 and to 9 and 10. This sequence is often, but not always, evident in the complete molt (see beyond) and corresponds to that of the proximal secondaries in the latter molt. The proximal locus may be obscured soon after replacement begins by the rapid replacement of coverts distal to 8. Nine and 10 are replaced at longer intervals; the juvenal tenth may still be present three weeks after replacement of distal coverts has begun. When distal coverts are retained, replacement begins at 8 or 9 and may involve no more than one or the other of these coverts; a variable number of neighboring coverts may be replaced, but when the proximal coverts of any first-year specimen are old and one or more distal ones are replaced, then in almost all such instances adventitious replacement has occurred.

(12) Upper tail coverts.—Replacement of upper tail coverts does not bear a sequence relationship to the spinal tract; such a relationship is observed between the under tail coverts and the ventral tract. In the former instance the oil gland separates coverts from the pelvic region. Molt begins less than a week after that of the under tail coverts, more than two weeks after that of the pelvic region. Replacement proceeds medially, the lateralmost feathers being lost first; this is also true of the under tail coverts.

(13) Middle primary coverts.—Replacement of these feathers is variable as it is in the corresponding secondary coverts; it begins about two weeks after that of the latter.

(14) Lesser under wing coverts.—In one of two caged birds observed through the postjuvenal molt, replacement of this series began along the middle and proximal portions more or less simultaneously, thence proceeding distally. In the other individual, only the outer half of the series was replaced. All other under wing coverts, exclusive of the marginals, were retained.

(15) Postcoronal area.—On the head, molt begins near the midline between the ears, or in what may be termed the postcoronal area. Replacement radiates from this locus, progressing most rapidly anteriorly and most slowly laterally. In the latter direction, molt spreads to the superciliary and supraauricular regions, thence to the ocular and auricular areas. A subsidiary, postauricular locus was observed on one caged bird; this was soon oblitered by the advance of molt from the top of the head laterally and posteriorly. The advance of molt from the postcoronal locus is met anteriorly by that from the frontal area.

(16) Frontal region.—Within the first week after the beginning of molt on the postcoronal area, replacement begins just behind the upper mandible and proceeds most rapidly posteriorly; it proceeds laterally to the rictal bristles and loral feathers, by which time the entire side of the head is undergoing active molt.

(17) Malar region.—Replacement begins lateral to the rami of the lower mandible at about the time growth of new feathers spreads laterally both along the midventral line and along the sides of the crown.

(18) Dorsal region. (19) Pelvic region.—Replacement begins at these two loci more or less simultaneously. It proceeds anteriorly and posteriorly from both centers, meeting between these two centers when the anterior line of advance is in the interscapular region. By the time this line of advance reaches the cervical region, it is met by that from the postcoronal area about five weeks after the inception of molt along the spinal tract. The last juvenal feathers to be dropped are those of the lateral neck region, both dorsally and ventrally.

GEOGRAPHIC VARIATION IN POSTJUVENAL MOLT

Molt of greater secondary coverts.—In all races of *A. coerulescens*, there is at least a partial replacement of greater secondary coverts during the postjuvenal molt (table 2).

Table 2

Number of Greater Secondary Coverts Retained through the Postjuvenal Molt in Different Populations of *Aphelocoma coerulescens*

Number of coverts	Males													Females										
	0	1	2	3	4	5	6	7	8	9	10	Total	Avge.	0	1	2	3	4	5	6	7	8	9	10	Total	Avge.
californica, north coast	5	4	2	4	1	1	0	0	0	0	0	17	1.7	6	3	2	2	1	1	1	3	0	0	0	19	2.6
oocleptica californica, south coast	19	10	8	8	1	2	3	2	0	0	1	54	1.8	10	11	7	5	3	2	3	1	0	0	1	43	2.3
obscura	9	10	6	7	0	4	2	3	0	0	0	41	2.3	1	4	3	5	3	0	1	3	0	0	0	20	0.9
cactophila and *hypoleuca*	18	6	13	9	3	2	4	0	0	0	0	55	1.9	10	12	6	5	6	5	0	1	0	0	0	45	2.1
insularis	16	0	1	0	0	0	0	0	0	0	0	17	0.1	21	2	0	0	0	0	0	0	0	0	0	23	0.1
superciliosa, north	17	6	4	2	1	1	0	0	0	0	0	31	0.9	4	5	4	0	0	0	0	0	0	0	0	13	1.0
superciliosa, south	13	3	2	3	6	7	0	4	1	0	0	39	2.8	1	2	2	5	3	2	3	3	0	0	1	22	4.2
nevadae, north	14	6	4	3	2	1	4	2	0	0	0	36	2.1	6	3	3	5	3	1	3	2	2	0	0	28	3.2
nevadae, south	2	6	4	2	2	1	0	1	0	0	0	18	2.2	1	1	2	0	1	2	0	0	0	1	0	8	3.5
woodhouseii, north	22	9	3	4	2	5	0	1	0	1	0	47	1.6	12	8	11	7	3	1	2	0	0	1	0	45	2.0
woodhouseii, south	9	9	3	5	1	3	0	2	0	0	1	33	2.2	3	4	1	1	2	1	1	1	0	0	0	14	2.5
texana	6	4	3	5	0	0	0	1	0	0	0	19	1.7	5	0	5	1	1	1	0	1	0	0	0	14	2.1
coerulescens	12	1	0	0	0	0	0	0	0	0	0	13	0.1	7	1	0	0	0	0	0	0	0	0	0	8	0.1
cyanotis	24	0	0	0	0	0	0	0	0	0	0	24	0.0	31	1	0	0	0	0	0	0	0	0	0	32	0.0
grisea	6	2	5	0	0	0	2	2	0	0	0	17	2.2	0	1	1	1	0	1	1	0	0	0	0	5	1.2
sumichrasti	1	0	0	0	0	0	0	0	0	0	0	1		0	2	0	0	0	0	1	1	0	0	0	4	
remota	0	0	0	1	0	0	2	0	0	0	0	3		0	0	0	0	1	0	0	0	0	0	0	1	
	1	0	0	0	0	0	0	0	1	0	0	2		5	0	0	0	1	0	0	0	0	0	0	6	

In four races representing three widely separated geographic areas, *coerulescens*, *texana*, *cactophila*, and *hypoleuca*, typically all coverts are replaced. Among the remaining North American races, the number of coverts retained tends to be higher in more northernly races (see table 2 and figures 41 and 42). From a comparison of corresponding sexes in figure 41, it may be seen that the number of coverts retained in *superciliosa* of Oregon and northern California is higher than in the population of the same race in the San Joaquin Valley and adjoining Sierra Nevada and the Tehachapi Mountains. This is also true of northern divisions of *nevadae* and *woodhouseii* when compared with their respective southern divisions, and of *californica* and *oocleptica* when compared with *insularis* and *obscura*. The difference in retention of coverts between *obscura* and the races to the south is an abrupt one. Although data on Mexican races are limited, it is evident from table 2 that replacement of greater secondary coverts in them is also variable.

This trend toward retention of more coverts in more northern races might be regarded as adaptive in view of the considerable difference in plumage wear between birds of relatively dry, warm regions as compared with those of cooler, more humid parts of the range of the same species. In those races in which replacement is most extensive (*hypoleuca, cactophila, texana,* and *coerulescens*), the possible added factor of early breeding season may be involved. Comparative data on breeding seasons of different races are not available. Another difference related to climatic contrasts, suspected but not established for *A. coerulescens*, is that of density of plumage (Wetmore, 1936); if the body plumage of northern birds subjected to more rigorous winters is denser than that of southern birds, the reduced postjuvenal molt might represent a compensatory adjustment. Most likely, of course, all of these factors have some bearing, at least, on the character of the molt. At the same time, the possibility that some of these differ-

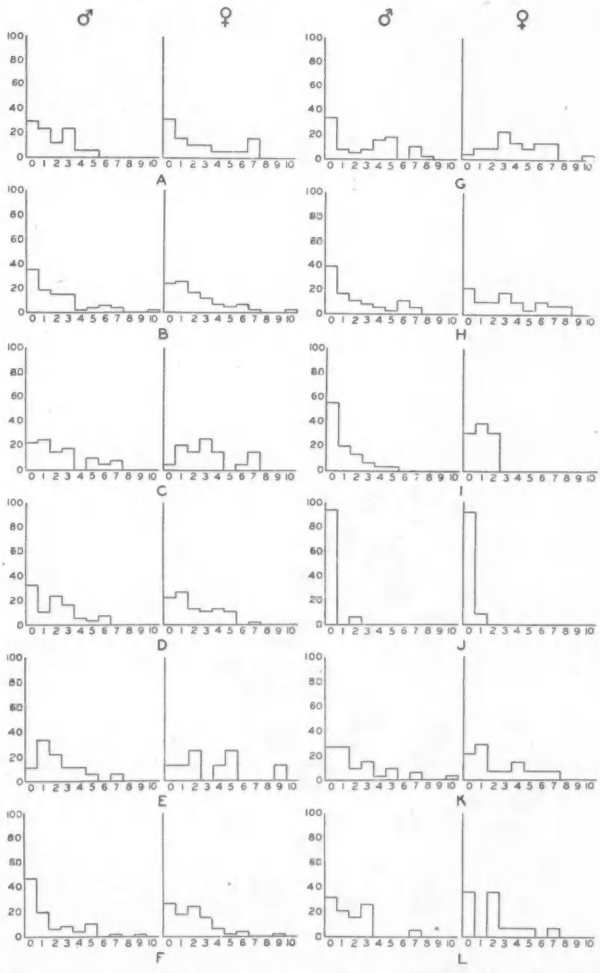

Fig. 41. Geographic variation in the number of juvenal greater secondary coverts retained during the postjuvenal molt of *Aphelocoma coerulescens*. Height of columns indicates percentage of population retaining number of coverts specified at the bases of columns. Data given in table 2. See legend of figure 40 for explanations of geographic groups. A, north-coast *californica*; B, *oocleptica*; C, south-coast *californica*; D, *obscura*; E, northern *nevadae*; F, southern *nevadae*; G, northern *superciliosa*; H, southern *superciliosa*; I, *insularis*; J, *hypoleuca* and *cactophila*; K, northern *woodhouseii*; L, southern *woodhouseii*.

ences are of historical derivation and, at present at least, non-adaptive should not be overlooked.

When the average number of coverts retained is compared between sexes of indi-

vidual populations or races (table 2), it is seen that if a difference exists, females retain the higher number. On the basis of the twelve instances in which a difference exists, the chance that the number retained by females would be higher in all of them in a random distribution may be calculated as less than one in one thousand.

Moreover, there is a tendency for the disparity between the two sexes to be greater when the average number of coverts retained is higher. This can be shown best by calcu-

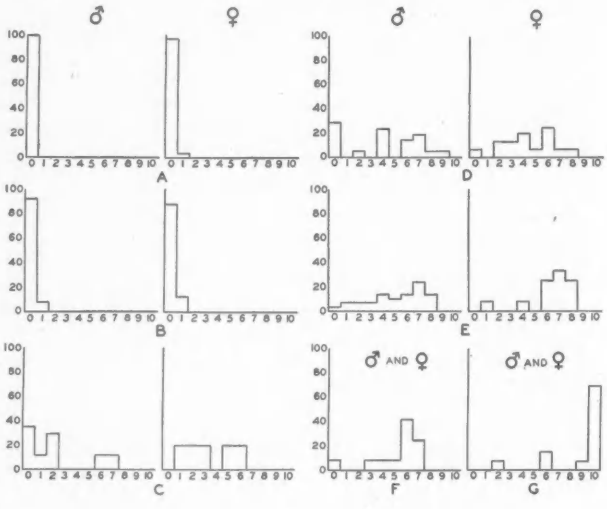

Fig. 42. Geographic variation in the number of juvenal greater secondary coverts retained during the postjuvenal molt of two species of *Aphelocoma*. See legend of figure 41 for explanation. A, *A. coerulescens coerulescens* (Florida); B, *A. c. texana* (west-central Texas); C, *A. c. cyanotis* (northeastern Mexico); D, *A. sordida couchii* and *A. s. sordida*, part (see table 5); E, *A. s. arizonae*; F, *A. s. wollweberi*; G, *A. s. colimae*, *A. s. sieberii*, and *A. s. sordida*, part.

lating the average number retained by males as per cent of the average number retained by females and then plotting these percentages against the respective common average value (male average + female average ÷ 2). The results of these calculations for each of the first fifteen populations listed in table 2 are plotted in figure 43. This evidence would indicate that when molt of the coverts is usually incomplete in any given race, males replace more coverts than females; furthermore, the less extensive the molt for the race, the greater the difference between the sexes.

Occurrence of asymmetry in replacement of greater secondary coverts not due to adventitious molt is rare. Practically all true instances involve a difference of one in the totals of coverts replaced on the two sides. This asymmetry was not seen in more than one or two per cent of the total number of individuals studied (table 2). The number recorded for all these individuals was arbitrarily the higher one.

Molt of rectrices and wing feathers other than greater secondary coverts.—Although other feathers normally retained through the postjuvenal molt may be replaced, such replacement is clearly adventitious as evidence of it is rare, scattered, and frequently

limited to one or several feathers. This is true of all races except *hypoleuca* and *cactophila*, in which the postjuvenal molt may involve the proximal four secondaries, the alula, greater primary coverts, and remiges (table 3). Molt of any of these series may be partial or complete. Molt of the secondaries is comparable to that of adults: the order of replacement is 8-9-10 and 7; when replacement is partial, the replaced feathers still

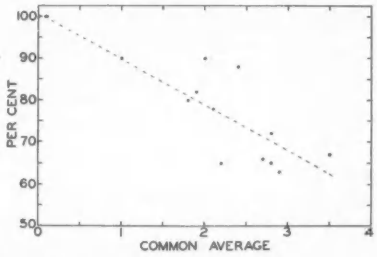

Fig. 43. Comparison between males and females of average numbers of greater secondary coverts retained during the postjuvenal molt. Dots represent number retained by males expressed as per cent of number retained by females in each of fifteen populations of *Aphelocoma coerulescens* (see text, page 242; also table 2).

fit this order. There is no evidence of correlation in the degreee to which inner secondaries, alula, and greater primary coverts are replaced, except that in those individuals which show at least partial replacement of greater primary coverts, the alula is completely replaced. The degree to which replacement of any of these feathers occurs in races other than *cactophila* and *hypoleuca* never exceeds four per cent and usually falls below two per cent of all individuals. In the latter instances, there is no evidence that the replacement is anything but adventitious.

Table 3

Replacement of Certain Alar Feathers and Rectrices in 41 First-year Specimens of *A. c. hypoleuca* and *A. c. cactophila*

	Complete replacement	Partial replacement	Total	Per cent
Secondaries 7-10	8	4	12	29
Greater primary coverts	1	3	4	10
Alula	7	4	11	27
Rectrices	3	4	7	18

Period of molt.—Comparison of the period of postjuvenal molt in different populations may be made by study of figure 40. The beginning of the molt period of south-coast *californica* and *oocleptica* (B) is comparable to that of *obscura* (C), but molt would appear to be completed sooner in the latter race. In north-coast *californica* (A), molt is later, and this is probably true even though the number of specimens involved is not great. A comparable difference is observed inland between northern and southern divisions of *superciliosa* (F, G, respectively); in the former, the molt is not only later, but proceeds more rapidly. In *insularis* (H), the few specimens are scattered rather widely on the time chart; as the data are limited, this is not necessarily to be interpreted as an indication of considerable variability in breeding period, since the late records might represent young of first-year, late-breeding birds. Differences between southern and northern divisions of *nevadae* (D, E) and *woodhouseii* (I, J) are obscure. There

is some evidence that molt proceeds more rapidly in *woodhouseii*. It would appear that in these last four instances, the similarity of the molt period (and, presumably, of the breeding period as well) is related to the marked seasonal periodicity of the climate (Great Basin and Rocky Mountain areas) which is particularly noteworthy for the ranges of these races when the latter are compared with birds of more coastal or southern distribution.

Data on races other than those considered above are limited. In *A. c. coerulescens, texana,* and *cyanotis,* molt apparently begins in June or July and is completed in late September or early October. In *hypoleuca* and *cactophila,* it begins earlier, in May or June, and proceeds slowly (see fig. 46A), probably occupying a period of at least four months. In *remota* and *sumichrasti,* the molt period is again long, beginning in June or July and ending in October or November, or, in some instances, even later. One specimen of the latter race (BS-144739) taken in Oaxaca on December 8, 1894, was not midway through the molt yet when collected!

Other evidence of geographic variation.—In *texana, woodhouseii, nevadae, hypoleuca,* and *cactophila,* the frontal molt locus may become active at the same time as, or sooner than, the postcoronal locus; in a few individuals of *woodhouseii* and *nevadae,* molt begins over the entire coronal area and spreads without evidence of two separate loci. In the Guerreran race *remota,* head molt is apparently retarded over that of the remaining parts of the body; in each of three specimens undergoing postjuvenal molt, the only ones available to me, the head is one full stage behind the body and wings in advance of molt. In two specimens of *sumichrasti* from Oaxaca and Puebla, respectively, however, this is not the case.

Discussion.—Parallel evidence of geographic variation in the postjuvenal molt of another passerine is provided by Miller's work (1931) on *Lanius* and adds significance to the findings reported here. In more northern populations of two or three races of *Lanius ludovicianus* ranging into southern Canada, replacement of coverts is partial; it is complete, or almost so, in remaining races (Miller, 1931:138). In *Lanius excubitor,* a northern species, replacement of greater secondary coverts is considerably less extensive than in any race of *L. ludovicianus*. Miller (*loc. cit.*) found partial replacement of greater primary coverts to occur in the Lower Californian race *grinnelli,* but not in any other. This was found true of the Lower Californian races of jays, *cactophila* and *hypoleuca*. In only these two races of jays does replacement of any remiges occur during the postjuvenal molt. Again in *L. l. grinnelli,* replacement of secondaries and primaries is more extensive than in other races of shrikes. The period of molt in *L. l. grinnelli* and another Lower Californian race, *nelsoni,* is more extended than in more northern races; the same is true of *A. c. cactophila* and *hypoleuca*.

COMPLETE MOLT

The second and all subsequent fall molts of corvids are typically complete molts. For purposes of comparison, eight arbitrary stages, based on Californian mainland races, have been defined (table 4). The first two involve initial steps in the replacement of remiges and rectrices, stages which are absent in the postjuvenal molt. The remaining six stages, in most respects, are comparable to those of the postjuvenal molt. In table 4, greater primary coverts are not mentioned; their replacement closely follows that of the primaries. Middle primary coverts are hidden on study skins by other, larger feathers, chiefly those of the alula.

Primaries 1-3 and their greater coverts are dropped in sequence and replacing feathers are at least partially grown before loss of any other feathers occurs. After molt of the primaries has begun, that of the coverts progresses more rapidly; the latter are all replaced with at least partially grown

Table 4

Arbitrary Stages of the Complete Molt in *Aphelocoma coerulescens*

Stage number	1	2	3	4
Primaries	1, 2 dropped; or breaking sheaths	1-2-3 full grown or almost so; 5-10 old	1-4 fully grown; 6- or 7-10 old	7- or 8-10 old
Secondaries		Old feathers intact; or 8 dropped	8 fully grown; 9, 7 breaking sheaths; 1 dropped; 10 old	7 half grown; 3-6 old; 1-2 partly grown
Greater secondary coverts		Dropped or breaking sheaths	Well grown	Growth complete
Middle secondary coverts		Old	Breaking sheaths	Partly grown
Alula				Old or dropped
Rectrices	Old	1-1 pin feathers to ⅓ grown	1-1 half grown; 2-2 dropped; others old	1-1 fully grown; 6-6 old; 2-2, 3-3 partly grown
Capital tract, dorsally		Old	Old	Feathers breaking sheaths on frontal and postcoronal areas
Spinal tract		Old	Feathers breaking sheaths	Superficial feathers old; many breaking sheaths or partly grown
Tail coverts		Old	New laterally, old medially	Half grown
Ventral tract		Old	Feathers breaking sheaths on sternal region	Sternal region refeathered; old feathers on throat

Stage number	5	6	7	8
Primaries	10 old	10 new, short		
Secondaries	7, 9 fully grown; 4-6 old; 10 well grown	6 old, or breaking sheath; 10 fully grown	6 partly grown	6 fully grown
Middle secondary coverts	Well grown	Growth complete		
Alula	Breaking sheaths	Partly grown	Well grown	Growth complete
Rectrices	3 pairs fully grown	6-6 half grown	6-6 fully grown	
Capital tract, dorsally	Frontal and postcoronal areas refeathered	Entire crown refeathered		
Capital tract, laterally	Old feathers on auricular area and sides of neck	Feathers of auricular area old mixed with new, partly grown ones	Active growth over entire auricular area	Some feathers not fully grown
Spinal tract	Scattered old feathers still present	Well grown	Some feathers not fully grown	Growth complete
Tail coverts	Well grown	Growth complete		
Ventral tract	Breast and belly refeathered; old feathers on lower throat	Old feathers on sides of lower throat	Feathers of sides of lower throat partly grown	Few feathers on sides of lower throat not fully grown

feathers by the time primary 8 is breaking its sheath. At about the time primary 4 is dropped replacement begins at secondary 8 and rectrices 1-1. With the replacement of secondary 8, most of the distal greater secondary coverts emerge. Proximal coverts usually emerge last, but occasionally the order is reversed, or distal and proximal loci may be evident, as in the postjuvenal molt. When replacement of the remiges has progressed to primary 5 and secondaries 9 and 7, and that of the rectrices has progressed to 2-2, body molt starts, as does also the replacement of secondary 1. Thus, replacement of remiges proceeds from two loci, secondary 8 and the carpal joint, in the following sequences: primaries

1-10, secondaries 8-10, 7 being replaced at the same time as 9 or shortly after, and secondaries 1-6. I have found no exceptions to this order in any species of *Aphelocoma*. Secondary 6 is usually only partly grown when growth of the distal primaries is completed. Middle secondary coverts (and probably middle primary coverts) together with marginal coverts are molted after most of the greater secondary coverts are well grown and when primary 5 is dropped. Molt of the middle secondary coverts occurs after that of the marginals has begun. When primary 6 or 7 is dropped, alular feathers are also dropped. Growth of new alular feathers is not completed until after the distal primaries are fully grown.

Body molt begins on the sternal region, or also on the dorsal and pelvic regions more or less simultaneously; soon after, that of the humeral, femoral, and crural tracts begins. When primary 6 or 7 is dropped, molt of head feathers begins. Replacement of upper tail coverts usually begins laterally and before that of the under tail coverts. As in the postjuvenal molt, the last old feathers to be dropped are those of the lateral cervical regions of spinal and ventral tracts. In both molts, the last feathers to complete their growth are those of the auricular, lateral occipital, and/or lateral throat areas; most frequently, final growth occurs in the auricular region.

The complete molt of *Aphelocoma* differs from the postjuvenal molt in the following ways: (1) Additional molt loci account, of course, for replacement of feathers normally retained by first-year birds; these are as follows: primary 1 together with greater primary covert 1; secondary 8; secondary 1; greater secondary coverts; middle coverts; and rectrices 1-1. (2) The sequence of replacement of the covert series is reversed: whereas in the postjuvenal molt, middle secondary coverts are replaced before greater coverts, the reverse is true in the complete molt; whereas in the former, molt of marginals may begin even before any other feathers are lost, in the latter, these are molted with the middle secondary coverts. In both molts, growth of new marginals begins at the time new feathers emerge on the sternal region. (3) Inception of molt on the sternal region always precedes that on the spinal tract in the postjuvenal molt; in the complete molt this occurs only occasionally, and then the time difference is only slight.

Period of molt.—In general, molt in *A. coerulescens* begins some time in June or July and is completed in September or October. In *oocleptica* (fig. 44B), the molt period lasts three months. The complete molt occupies a slightly longer period of time than the postjuvenal molt.

First complete molt.—The first complete molt of birds one year of age is initiated, sometimes, before that of older individuals of a given population and usually within the first half of the molt period of the population. Thus, of twenty-eight individuals of *A. coerulescens* and *A. sordida* undergoing that molt, seven (25 per cent) began to molt earlier than older individuals, 19 (68 per cent) began to molt with the first 50 per cent of older individuals, and two (7 per cent) with the last 50 per cent. In *A. coerulescens*, with rare exceptions, it is not possible to identify an individual in the first complete molt after stage 5 has been reached; in *A. sordida*, however, individuals in late stages of the first complete molt can be identified if the bill has a considerable area of yellow coloration (see page 256).

Irregularities in sequence of molt apparently occur more frequently in the first complete molt than in either the postjuvenal or later complete molts. The irregularities are almost always minor, however; for example, molt may begin on the loci of the capital tract sooner than normal in relation to other body loci; the body molt as a whole may be somewhat ahead of wing molt. Other examples are discussed for *A. unicolor* and *A. sordida* below. The irregularities of the first complete molt may well be related to the fact that some first-year birds do not breed.

GEOGRAPHIC VARIATION IN THE COMPLETE MOLT

Period of molt.—In races of *A. coerulescens* distributed over the western United States, as is evident from figure 44, molt generally does not begin later than July 31,

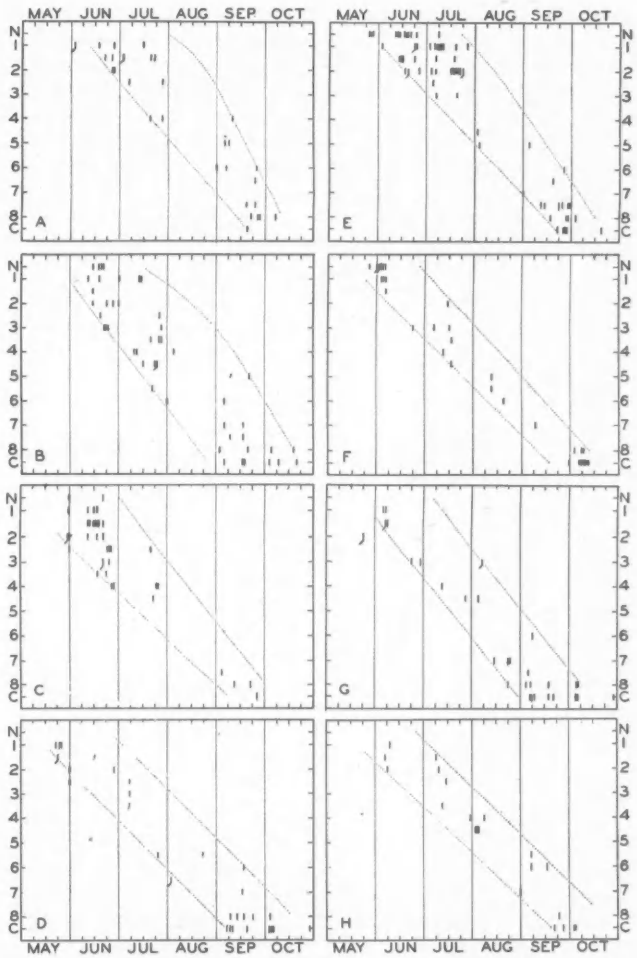

Fig. 44. Period of complete molt in different races of *Aphelocoma coerulescens* in western North America. Molt stages described in table 4; N, no signs of molt; C, molt completed. Individuals undergoing first complete molt indicated by a hook at lower end of vertical line. See legend of figure 40 for explanation of geographic groups. A, north-coast *californica*; B, *oocleptica* and south-coast *californica*; C, northern *nevadae*; D, southern *nevadae*; E, northern *superciliosa*; F, southern *superciliosa*; G, northern *woodhouseii*; H, southern *woodhouseii*.

nor is it completed sooner than September 1. In coastal California (fig. 44A, B), the molt period lasts three months. Along the north coast, the rate of replacement appears to be higher than to the south. There is a difference of about fifteen days between the

lines representing the onset of molt of north-coast *californica* and of south-coast *californica* and *oocleptica*. A comparable difference occurs between interior populations of *superciliosa* (fig. 44E, F), but the molt period of the latter is longer than that of the coastal populations. These observations confirm those made earlier of the postjuvenal molt.

The molt periods of *insularis* and *obscura* (fig. 45A, D) are comparable to those of *californica*. Between northern and southern divisions of *woodhouseii* (fig. 44C, D)

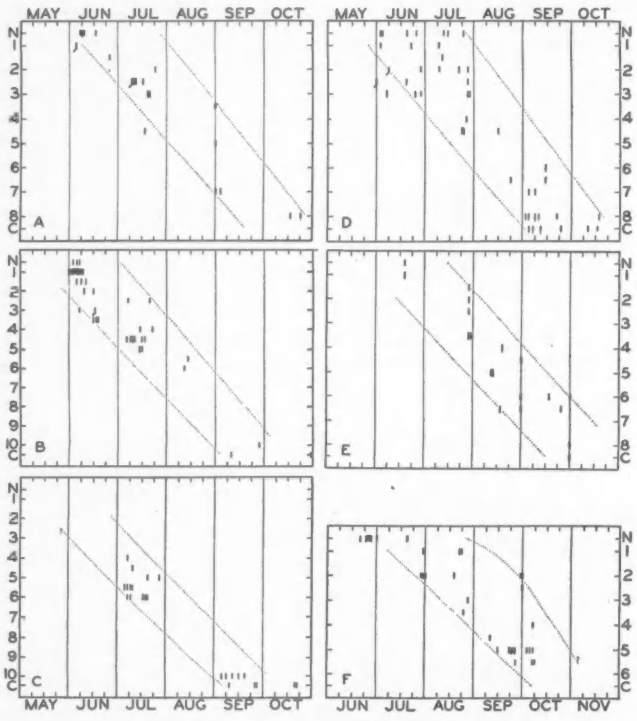

Fig. 45. Period of complete molt in different species and races of *Aphelocoma*. See tables 1, 4, and 6 for description of molt stages; N, no signs of molt; C, molt completed. A, A. *coerulescens insularis*; B, *A. sordida couchii* and *A. s. sordida* north of San Luis Potosí; C, *A. s. colimae*; D, *A. coerulescens obscura*; E, *A. c. cyanotis*; F, postjuvenal molt of *A. sordida arizonae*.

and of *nevadae* (G, H), no differences are evident, although there is a suggestion of a slightly higher rate of molt in the northern populations. In *texana*, molt period is comparable to that of southern *woodhouseii*. In *cyanotis* (fig. 45E), molt proceeds at the same rate as in those races just to the north but it occurs slightly later.

In all races considered thus far, except those along the Californian coast, molt occupies a period of three and one-half to four months. In *hypoleuca* and *cactophila*, this

period is at least four months and probably longer. Because the number of molting specimens of these two races was small, the evidence for longer molt period, as shown in figure 46A, is augmented by comparable evidence from specimens undergoing the postjuvenal molt. The nine available molting specimens of *sumichrasti* and *remota* indicate that in these races, also, the complete molt lasts at least four months.

Differences in local inception of molt.—In *woodhouseii* and *texana* (and probably *nevadae, cactophila,* and *hypoleuca,* as in the postjuvenal molt), replacement on the capital tract may begin at the frontal locus before, or at the same time as, that of the

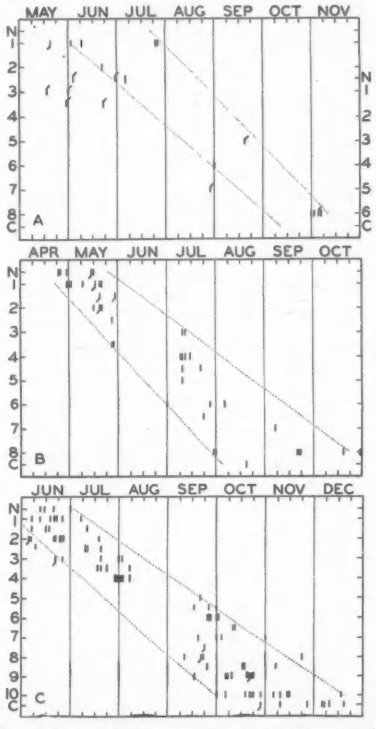

Fig. 46. Period of complete molt of *A. coerulescens hypoleuca* and *A. c. cactophila,* shown in A (individuals in postjuvenal molt indicated by hook at upper end of vertical line); of *A. unicolor,* all races, B; and of *A. sordida arizonae,* C. See legend of figure 44 for explanations.

postcoronal locus. The same is true of *sumichrasti* and *remota*; in these races, furthermore, molt of the ventral tract begins on the upper abdominal region and not on the sternal region, although it soon spreads on to the latter. This last departure from other races of *A. coerulescens* is not evident in the postjuvenal molt of these races.

In *cyanotis,* molt sequence is comparable to that of more northern races (ten specimens in stages 1-8); or the wing and tail molt may begin to lag at stage 2 so that by the time stage 6 is reached, delay in molt of these parts may amount to two full stages

(six specimens in stages 2-6 of body molt). This peculiarity of *cyanotis* may be related to the fact that although its molt proceeds at a rate comparable to that of more northern birds, replacement of its longer remiges, in some individuals at least, occupies a longer period of time. Average wing length of adult males is 139.7 mm., that of typical *woodhouseii*, 130.9, of *californica*, 123.0.

In *insularis*, replacement of the proximal four secondaries lags one stage behind the molt of other parts of the alar tract; growth of these feathers is completed at about the same time as that of the distal primaries.

MOLT IN APHELOCOMA UNICOLOR

Postjuvenal molt.—Although only six specimens of this species in the postjuvenal molt were available to me, several noteworthy observations can be recorded from them. Molt occurs in June, July, and August and apparently may be completed by early September. It probably begins in late May or in June. Unlike the postjuvenal molt of *A. coerulescens*, molt along the ventral tract begins on the upper abdominal region, not on the sternal region, but proceeds anteriorly rapidly so that the advance of the abdominal over the sternal region is usually only slight. Molt of the capital tract is similar to that of inland and Mexican races of *A. coerulescens*; it may begin at either frontal or postcoronal loci or at both more or less simultaneously. Molt of the alar tract is less extensive than that of *A. coerulescens*. All greater secondary coverts are often retained (table 5). In fifteen first-year specimens, nine or 60 per cent retained all coverts; of the remaining 40 per cent, none shows replacement of more than three proximal feathers. Further, a variable number of middle secondary coverts is often retained. This, to my knowledge, is never true of *A. coerulescens*.

Complete molt.—An adequate number of specimens undergoing complete molt was available for tabulation of arbitrary molt stages, which correspond to those of *A. coerulescens* fairly closely (fig. 46B). As was true of the postjuvenal molt, replacement along the ventral tract begins on the upper abdominal region. Comparable or greater variation in head molt occurs in adults; in some instances, head molt may begin on the frontal *and* malar loci and proceed posteriorly *and laterally* before any replacement at the postcoronal locus begins. It is possible that a postcoronal locus is lacking in at least some individuals.

Perhaps the chief contrast in the molts of *A. coerulescens* and *A. unicolor* is the comparatively great variation in *unicolor* in time at which certain molt loci become active. The consequence of this is a partial breakdown of the characteristic time sequence of inception of molt at different loci, as determined for *A. coerulescens*. So far as can be determined from study skins of *A. unicolor*, molt loci—the specific areas as well as the manner of spread of molt from them—are comparable in the two species (with exceptions noted above). But the sequence of molt in *A. unicolor* may be similar to that of *A. coerulescens* (table 4); this is true of available specimens from Honduras and Guatemala and of some from other regions. Or activity of spinal- and ventral-tract loci may become evident when the wing and tail are at stage 2; of five specimens from Chiapas in early stages of molt, this is true of all. Or delay may occur at these loci and molt on the body as well as the head begin at about the same time, when wings and tail are at or near stage 4; among eight specimens from Vera Cruz, this is true of four, three conform to the sequence given in table 4, and the last, at stage 4, has the central pair of rectrices only one-half grown. One specimen from Guerrero (BS-185538) is similar to those from Chiapas; seven others are in the earliest or latest stage and thus provide no evidence of variation in molt sequence. But in two Guerreran specimens

(BS-185542, 185544) of four undergoing the first complete molt, body molt has begun even before that of the tail. The molts of wings and tail, here as in *A. coerulescens*, are correlated quite closely, they extend over a long period of time, and they constitute the chief basis for estimating molt stage. Thus, the greater variation in body molt of *A. unicolor* does not in any way invalidate the method of using arbitrarily defined molt stages for timing molt; as a matter of fact, it has added the value of providing good basis for detecting and evaluating just such differences as are described above. Too few specimens of *A. unicolor* are available to establish interracial and intraracial differences on the same basis as in *A. coerulescens*, but it is evident from the data given above that in this southernmost species of *Aphelocoma*, inter- as well as intra-racial variation is greater than in *A. coerulescens*. As will be shown below, interracial, but apparently not intraracial, variation of a similar order occurs in *A. sordida*.

The molt period of *A. unicolor*, estimated from a plotting of all available molting specimens of the species as a whole (fig. 46B), apparently lasts from three and one-half months to five months. In general, molt begins in May and is completed in August (Guatemala, three specimens), September (Chiapas, four specimens), or October (Guerrero and Oaxaca, two specimens).

Although specimens taken in other months of the year were examined for evidence of molt, none was found except in a series from Honduras. Of 32 specimens taken there in January and February, five or 16 per cent were at or near stage 6 of the complete molt. These were collected between January 25 and February 10, 1936, at Alto Cantoral. The remaining, non-molting specimens consist of 22 adults and three first-year birds. Of the five undergoing molt, four show some yellow coloration near the inner end of the lower mandible; the fifth shows but a vague suggestion of color. Bill coloration would suggest that these individuals may have been passing through the first complete molt (see page 256). But they probably do not represent more than one or two broods; two additional specimens in adult plumage taken at the same locality on February 10, 1936, although showing some yellow color on the lower mandible, are not in any stage of molt.

MOLT IN APHELOCOMA SORDIDA

Postjuvenal molt.—In *A. s. arizonae*, this molt is similar to that of *A. coerulescens*. For the most part this applies to other races of *A. sordida*, but to varying degrees. Thus, on certain specimens of *sordida* from southern Tamaulipas and in *wollweberi* from northern Jalisco, the head molt, in terms of stages given in table 1, is ahead of that of body and wings. This difference in molt sequence is striking in specimens of *sordida* from Hidalgo; from these it is evident that in this race, middorsal loci of the capital and spinal tracts may become active at about the same time as that on upper abdominal and sternal regions. Replacement of middle and greater secondary coverts is delayed one stage or proceeds more slowly. Too few specimens are available to state how generally this is true of the Hidalgo population. At any rate, these observations are evidence for marked geographic differences and, within some races, individual differences in the postjuvenal molt of *A. sordida*. In character of interracial differences, *A. sordida* compares with *A. unicolor* but contrasts with *A. coerulescens* in which evidence for differences of such magnitude was limited to the Guerreran race *remota*.

In *arizonae*, the postjuvenal molt begins in July or August and is completed in October or, probably, early November (fig. 45F). Compared with the southern division of *A. coerulescens nevadae* (mainly Arizona), molt occurs about one month later.

In other races of *A. sordida*, postjuvenal molt apparently begins earlier. Thus, of eight molting specimens of *couchii*, the average date of two from Texas and Nuevo Leon

in stage 1 (table 1) is June 15; the average date of two from Texas in stage 6 is October 12. Of eleven specimens of *wollweberi*, the date of two from Durango in stage 1 is July 22; the date of one from Sinaloa in stage 6 is September 26. In both the preceding instances, molt stages and dates of remaining specimens fall between the given extremes. The molt of four specimens of *sordida* from San Luis Potosí in middle or late stages, all collected in late August and September, can be estimated to reach completion by October 15. On one specimen from Michoacan (FM-119200), collected on July 15, 1940, the molt is advanced (stage 5). Thus, the available specimens suggest that molt in *arizonae* lags behind that of populations of *A. sordida* to the east and south.

Table 5

Number of Greater Secondary Coverts Retained through the Postjuvenal Molt in Different Populations of *Aphelocoma sordida* and in *Aphelocoma unicolor*

	Sex	Number of coverts												
		0	1	2	3	4	5	6	7	8	9	10	Total	Avge.
Aphelocoma sordida														
New Mexico, Arizona, northern Sonora, northwestern Chihuahua	M	0	2	2	2	4	3	4	7	4	0	0	29	5.1
(= *arizonae* of Hellmayr, 1934)	F	0	1	0	0	1	0	3	4	3	0	0	12	6.2
Texas, states of Coahuila, Nuevo Leon, and Tamaulipas	M	6	0	1	0	5	0	3	4	1	1	0	21	4.0
(= *couchii* and *sordida*, part)	F	1	0	2	2	3	1	4	1	1	0	0	15	4.4
Durango, Sinaloa, Zacatecas, northern Jalisco (= *wollweberi*)	Both	1	0	0	1	1	1	5	3	0	0	0	12	
Jalisco, Colima, Michoacan, Morelos, Vera Cruz, Hidalgo (= *colimae*, *sieberii*, and *sordida*, part)	Both	0	0	1	0	0	0	2	0	0	1	9	13	
Aphelocoma unicolor	Both	0	0	0	0	0	0	0	2	3	1	9	15	

Extent of molt of wing coverts varies from complete replacement of greater and middle secondary coverts to retention of all these. Most extensive data are available for *arizonae* and *couchii* (table 5, fig. 42). In these races the number of coverts retained is higher than in any race of *A. coerulescens* for which data are adequate. Among races of *A. sordida*, most extensive replacement occurs in *couchii*, while greatest number of coverts is retained in the southern races (table 5). In the latter, as in *A. unicolor*, variation occurs in the extent of replacement of middle secondary coverts, and all may be retained. A sexual difference in number of coverts retained is shown in table 5 for *couchii* and *arizonae*; in this respect, *A. sordida* is apparently similar to *A. coerulescens* (see also fig. 42). Finally, it may be noted that in extent of postjuvenal molt of the wing, *A. sordida* varies more than either *A. unicolor* or *A. coerulescens* and is, as a matter of fact, more or less intermediate between them.

But one instance of replacement of proximal secondaries during the postjuvenal molt was found in *A. sordida*. In the Michoacan specimen mentioned above, secondaries 8 and 9 and the center pair of rectrices have been replaced.

Complete molt.—The study of the complete molt of *A. sordida* was based on the race *arizonae* which was represented by the largest number of specimens. Soon after this was begun, it became evident that the molt process occupied a longer period of time than in *A. coerulescens* and that molt of the body tracts in particular was protracted. This necessitated the formulation of another series of arbitrary stages, and

ten were defined. From the tabulation of these stages (table 6), it can be seen that molt sequence in *A. sordida* is similar to that of *A. coerulescens*, and this applies as well

Table 6

Arbitrary Stages of the Complete Molt in *Aphelocoma sordida*

Stage number	1	2	3	4	5
Primaries	1-2 dropped; or 1 breaking sheath to half grown	1-2 one-third grown; 3 breaking sheath; 5-10 old	6-10 old	7-10 old	9-10 old
Secondaries		8 breaking sheath; 1-7, 9-10 old	8 half grown; 9 breaking sheath; 10 old	8-9 well grown; 7 dropped or old; 10 old; 1 partly grown	8-9 fully grown; 3-6 old; 10 old
Greater secondary coverts		Breaking sheaths along entire series	Majority well grown	Growth complete	
Middle secondary coverts		Old	Dropped	Partly grown	Growth complete
Alula					Old
Rectrices	Old	1-1 breaking sheaths	1-1 half grown	1-1 fully grown	3 pairs fully grown
Capital tract, dorsally			Old	Pin feathers over crown area	Half refeathered; old feathers on back of neck
Capital tract, laterally				Old feathers	Old or some breaking sheaths
Spinal tract			Old	Some new feathers evident superficially	Refeathered; some old feathers evident superficially
Ventral tract		Old	Feathers breaking sheaths on sternal area	Sternal area refeathered; feathers breaking sheaths on interramal area	Superficial feathers of lower throat old; new feathers breaking sheaths below

Stage number	6	7	8	9	10
Primaries	10 old	10 old	10 breaking sheath		
Secondaries	7-9 fully grown; 4-6 old	4 partly grown; 5-6 old	6 old or breaking sheath	6 not fully grown	
Alula	Breaking sheaths	Half grown	Well grown	Growth complete	
Rectrices	3 pairs fully grown	4 pairs fully grown	Outer pair half grown	Growth complete	
Capital tract, dorsally	Refeathered	Most feathers not fully grown	Some feathers not fully grown	Growth complete	
Capital tract, laterally	Partly grown and old feathers mixed	Most feathers not fully grown; a few old feathers still present	Growth incomplete	Growth incomplete	A few feathers not fully grown, chiefly on auricular area
Spinal tract	Most feathers not fully grown	Growth incomplete	Growth incomplete	A few feathers not fully grown	Growth complete
Ventral tract	Old feathers on sides of throat only	Growth incomplete on throat, breast, and belly	Growth incomplete	A few feathers not fully grown on throat, breast and belly	Growth complete

to molt of pterylae not mentioned in table 6. Molt loci, so far as can be determined from study of dried skins, are also comparable.

The molt period of *arizonae* is, so far as is known now, longer than that of any other race or species of *Aphelocoma*. Molt begins usually in June, but may begin in late May (fig. 46C); it is completed in October, November, or December. Thus, molt

may occupy a period of from over four months to almost six months.

The chief geographic difference in complete molt noted was an advance, in terms of stages given in table 6, of the body molt over the wing and tail in more southern races. In fourteen of sixteen specimens from Zacatecas and northern Jalisco, chiefly in middle stages of molt, body molt is advanced one or two stages. The same is true in ten of thirteen specimens from Michoacan, and in two of thirteen from southern Jalisco and Colima.

Comparison of length of molt period can be made among several geographic groups of *A. sordida* by study of figure 45B and C, and figure 46C. In *couchii*, the molt period is about three and one-half months. In *colimae*, it is at least three and one-half months, and probably longer; the individuals plotted in figure 45C were all collected in 1905 at a few localities in the Sierra Nevada de Colima. In other races, molt occupies a longer period. Data from 24 molting specimens from Vera Cruz, Puebla, Mexico, and Michoacan indicate that molt occurs between May 15 and September 15, a period of four months. Eleven molting specimens from San Luis Potosí and Hidalgo were taken within the period June 1-October 1 (four months). Twenty-six molting specimens from northern Jalisco and Zacatecas were taken within the period June 15-October 31 (four and one-half months). Thus, the shortest and longest molt periods in *A. sordida* are found in populations at the two northern apices, eastern and western, respectively, of a roughly U-shaped geographic range. This conclusion is a puzzling one inasmuch as in *A. coerulescens*, southern races (Lower California and Mexico) show longer periods. It is my opinion that this evidence has historical significance, but an interpretation of it is not warranted without evidence from other sources.

Perhaps the most puzzling specimen in molt examined in this study is that of a male *A. sordida* (BS-144653) taken at Patzcuaro, Michoacan, on July 24, 1892. All coverts except the greater primary series are recently replaced, Although some of the remiges are missing, there is no sign of normal replacement! Two pairs of new rectrices are fully grown; some old feathers are still retained laterally. Body molt is beginning on dorsal, frontal, and sternal regions, but is most advanced on the interramal region! On the basis of the character of the remiges and old rectrices, the dull greater primary coverts, and the yellow coloration of the lower mandible, the specimen is judged to be a first-year bird, probably non-breeding, undergoing the first compelte molt. Irregularities in the first complete molt have been noted in *A. coerulescens* and *A. unicolor*, but none of these was so striking as that described here.

AGE DETERMINATION

Plumage characters.—It is clear from the differences between postjuvenal and complete molts discussed above that if the retained juvenal feathers are distinguishable from corresponding ones of adults, basis is provided for segregating first-year individuals from adults. A number of distinguishing characters involving rectrices, remiges, and wing coverts are available. These apply to all species of *Aphelocoma*. Comparable differences have been described for *Corvus* by Emlen (1936:99). The existence of some of these differences in *Aphelocoma* has been noted in the past (Swarth, 1904:32; Dickey and van Rossem, 1938:409), but no attempt has yet been made to describe them precisely.

1. The rectrices of the first-year bird are rounded or bluntly pointed; those of adults are usually truncate (fig. 47A, B).

2. The same difference, although not so marked, is observed between outer primaries of the two groups (fig. 47D, E).

3. The retained juvenal alular feathers, greater primary coverts, and, if any, greater

secondary coverts are of a duller coloration than greater or middle secondary coverts acquired during the postjuvenal molt. The contrast is especially evident if the series of greater secondary coverts has undergone only partial replacement. If not worn, the

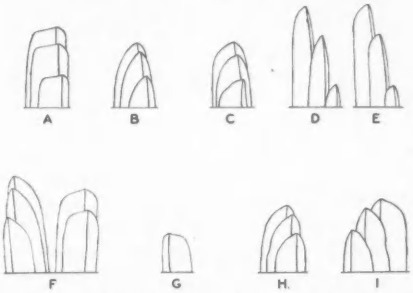

Fig. 47. Shape of lateral rectrices (A-C, F-I) and outer primaries (D, E) in adult and first-year specimens of *Aphelocoma coerulescens*. A, adult male, Monterey County, California, October 10, 1914 (FM–142456); B, juvenal male, San Benito County, California, July 12, 1918 (MVZ–29180); C, adult, female?, Monterey County, California, January 29, 1919 (MVZ–30356); D, same as B; E, adult male, San Luis Obispo County, California, October 4, 1918 (MVZ–29744); F, juvenal male, Mendocino County, California, August 22, 1909 (MVZ–10498), two rectrices of adult form apparently acquired early in the postjuvenal molt; G, first-year specimen, female?, Cedar Keys, Florida, January 23, 1874 (LCS–8321), tail completely replaced; H, first-year female, Marin County, California, November 18, 1915 (FM–70600), tail undergoing complete replacement when specimen was collected; I, first-year male, Elko County, Nevada, December 26, 1927 (RE–4599), only three rectrices shown replaced.

juvenal coverts are tipped with dull grayish brown; the adult coverts are blue throughout. If evidence from other characters listed here is questionable, coverts will almost always serve to classify the specimen satisfactorily. Emlen (1936:100) does not mention covert characters, but the differences are as clear in *Corvus* as in *Aphelocoma*.

4. Rectrices and remiges of first-year birds are typically more worn than those of adults. This, however, is not a reliable means of distinguishing the two age classes; but specimens with excessively worn flight feathers are almost always first-year birds. I have used this character in spotting first-year birds in the field in spring, when, in the vicinity of Berkeley, the wear shown by adults is moderate or negligible.

5. The tail of first-year birds is not so rounded as that of adults. This may be shown by differences in length between the longest rectrices and those next to the outermost (Emlen, 1936:101) summarized in table 7.

Table 7

Differences between Length of Rectrices of Adult and First-year Birds

		Males			Females		
		Number	Range	Mean	Number	Range	Mean
A. c. californica	Adult	17	10-20 mm.	15.8 mm.	12	8-16 mm.	12.0 mm.
	First-year	19	7-15	10.9	10	8-10	9.3
A. s. arizonae	Adult	18	8-14	11.4	10	5-10	8.8
	First-year	7	3- 8	5.3	8	2- 5	4.1
A. u. guerrerensis	Adult	12	21-27	23.8	9	19-25	22.0
	First-year	0			2	13-16	14.5

In juvenal or first-year individuals, the longest rectrices are 2-2; 1-1 are five to ten millimeters shorter than 2-2. In adults, with rare exceptions, when the difference between 1-1 and 2-2 is very small, the longest rectrices are the center pair.

As pointed out by Emlen (1936:102), the characters serving to distinguish first-year from adult birds are not to be used individually, but in combination, one supplementing the others. Reliance upon the obvious character of rectrix shape should especially be avoided inasmuch as adventitious replacement may produce rectrices of adult form (fig. 47F, G), although in some instances of fall or winter replacement during the first year, the new feathers are of juvenal form (fig. 47H, I). On the other hand, adult rectrices are not necessarily truncate and, indeed, may be strongly suggestive of juvenal feathers (fig. 47C); in the latter, comparatively rare instances, the character of the greater coverts together with the sturdier structure and more intense coloration of the flight feathers indicate that the specimens in question are adults.

First-year birds also differ from adult birds statistically in size and color characters. A discussion of these differences is not in order here; rather these are differences whose sound determination depends on the separation of age classes in terms of the characters described above. An example will serve to illustrate the magnitude of difference in selected siz characters. Thus, in wing and tail length, age classes of the two sexes differ in north-coast *californica* as shown in table 8.

Table 8

Sex and Age Differences in Lengths of Wing and Tail

		Wing			Tail		
		Number	Range	Mean	Number	Range	Mean
Males	Adult	38	119.7-128.2 mm.	123.0 mm.	36	131.0-145.7 mm.	136.8 mm.
	First-year	25	117.0-125.1	121.8	25	125.0-144.1	133.8
Females	Adult	29	114.6-122.5	119.0	28	125.0-137.7	131.1
	First-year	32	113.0-122.2	116.8	31	120.0-131.7	125.7

From my use of data of this type in studies of the genus *Aphelocoma*, I have concluded that separation of age classes is absolutely essential if correct interpretations of variation and racial differences are to be made. Any work on the systematics of corvids in which first-year specimens are not distinguished from adults is at once suspect.

Bill color.—In *A. unicolor* and *A. sordida*, but not in *A. coerulescens*, the bills, especially the lower mandibles, of birds which have passed through the postjuvenal molt are colored yellow to a varying degree. Although various shades of yellow on dried specimens, the bill in life, at least in *A. sordida*, is presumably more flesh colored (Ridgway, 1904:338); in *A. unicolor griscomi*, the color is greenish yellow (Dickey and van Rossem, 1938:410). Although the majority of specimens with partly colored bills, excluding juveniles, are first-year birds, a segregation of age groups using bill color as a criterion (Swarth, 1904:31; Dickey and van Rossem, *loc. cit.*) cannot be made.

Changes in bill color are clearly evident from a large series of specimens of *A. s. arizonae* which I have examined. The bill of the young nestling is largely or entirely yellow. As the time for departure from the nest approaches, the outer half of the upper mandible and the outer lateral areas of the lower mandible begin to darken. During the fledgling period and before the postjuvenal molt, the base of the upper mandible and most of the lower mandible are usually yellow. This amount of light coloration, arbitrarily defined as stage 1 in the process of darkening of the bill (table 9), may be retained through the postjuvenal molt and into the first year as late as May. During the first year, the area of yellow is gradually reduced: the base of the upper mandible darkens, the last parts to lose the yellow color usually being the proximolateral edges; at the same time, the distal half of the lower mandible darkens, later the inner half and rami. By the time darkening occurs over the rami, the upper mandible is usually entirely dark; the last area to lose the yellow color is, in most instances, that around the inner

end of the gonys. In table 9, extent of light coloration of the bill in first-year and adult specimens is shown in relation to sex and season of year. These data clearly indicate the progressive darkening of the bill.

Considerable variation occurs in the time taken by the process of darkening (table 9). The bill may become black before the individual has reached the age of one year.

Table 9

Extent of Light Coloration on Bills of Specimens of *Aphelocoma sordida arizonae* in Relation to Age, Sex, and Season of Year

Stages of increasing area of black	Males					Females					Both sexes, black	Total specimens
	1	2	3	4	5	1	2	3	4	5		
First-year specimens:												
Sept.-Nov.	4	4	3	4		3	1					19
Dec.-Feb.	1		2			3	1		2			9
March-May	2	2	7	3	2		2		3			21
June-Aug.				3	2			1	4			10
Adult specimens:												
Sept.-Nov.		1	1	15	8		1	2	6	6	12	52
Dec.-Feb.				6	5				6	1	14	32
March-May				4	10				8	6	58	86
June-Aug.				1	7				3	8	27	46
Total specimens examined												275

This is shown by two April-taken and two June-taken first-year specimens, the bills of which are practically all black. These four specimens represent seven per cent of the total of 59 first-year specimens examined.

On the other hand, on many specimens which have passed through the first, and possibly the second, complete molt, irregular areas or streaks of light color are present on the proximal ventral surface of the lower mandible (table 9). These individuals were at least one year old when collected; but it is not possible to segregate them as second-year individuals, as others of the same age have black bills. Of a total of 216 specimens which are more than one year old, 105, or 49 per cent, have some yellow on the lower mandible. The latter include nine specimens taken in July or August which earlier have passed through at least one molt and probably not more than the first complete molt. It is evident, then, that yellow color of the bill may disappear from the ages of slightly less than one year to more than two years.

The data of table 9 also indicate that there is a tendency for males to acquire black bills before females. Thus, among first-year specimens, 10 per cent of the males, but none of the females, are in stage 5. Among adults showing some yellow coloration, 55 per cent of the males are in stage 5, but only 45 per cent of the females.

In other races of *A. sordida*, bill color behaves in a similar manner except in *A. s. couchii* (Van Tyne and Sutton, 1937:61) and of *A. s. sordida* exclusive of southern Hidalgo. In these races the bill darkens rapidly during nestling life and becomes black before or during the postjuvenal molt. The same is true of *A. coerulescens*.

With slight variations, the darkening of the bill in *A. unicolor* proceeds in the same manner as in *A. sordida arizonae*. The yellow areas of the bill of *A. unicolor* are brighter in dried specimens; apparently in life, the color contrast of a partly black bill is more striking than in *A. s. arizonae*. It appears that the darkening may proceed most rapidly in northern forms of this species. In four specimens from Honduras and Guatemala which have passed at least through the first complete molt, the lower mandible, although largely black, still has conspicuous areas of yellow. Among specimens from Vera Cruz

and Guerrero, however, all those which have passed through one complete molt have dark bills. Furthermore, of three specimens from Vera Cruz in stages of the first complete molt, two have black bills and one has a small light spot on the lateral surface of one ramus. The bill of one first-year specimen from Guerrero (BS-185545) taken on May 16, 1903, is almost black. On two adults from Chiapas, taken in September and March, respectively, there are one or two small light streaks or spots on the lower mandible of each; otherwise, bills of adult specimens from this state are also entirely black.

SUMMARY

The feather-tract pattern of American jays of the genus *Aphelocoma* is figured in detail and compared with *Lanius* (Miller, 1931). Distinctive features of *Aphelocoma* are absence of frontal and rictal apteria, reduced temporal apterium, presence of only ten upper and ten under tail coverts, and posteriorly undivided sternal region of the ventral tract. *Aphelocoma* lacks a middorsal apterium present in some corvids; also, the dorsal region of the spinal tract is not acute-angled as in some corvids. Twenty remiges are present in *Aphelocoma* and in most other corvids.

Sequence and extent of molts, and the nature and extent of intra- and inter-specific differences in molt of *A. coerulescens, A. sordida,* and *A. unicolor* have been studied using 1910 study skins. Two caged individuals of *A. c. oocleptica* were observed through the postjuvenal molt.

Prior to the postjuvenal molt of *A. coerulescens,* marginal feathers of the wing of a blue color brighter than that of greater and middle upper wing coverts emerge at or near the time of departure from the nest. Dark feathers of head, neck, and collar areas replaced adventitiously before the postjuvenal molt are also blue, not brown, in color. Under wing coverts emerge after departure from the nest. The postjuvenal molt begins about five weeks after departure from the nest; it is a partial molt and does not involve, in general, the feathers of the alula, greater primary coverts, remiges, rectrices, a variable number of greater secondary coverts, and a variable number of under wing coverts. Normal replacement of some or part of these feather series occurs only in the races *hypoleuca* and *cactophila.*

In the postjuvenal molt, northern races tend to retain more greater secondary coverts than southern races; females tend to retain more of these coverts than males. As the average number of coverts retained increases from one population to another, the disparity between males and females in number of coverts retained tends to increase.

The molt locus is defined as a small area on any feather tract on which molt begins independently of that in other areas in space, but not in time; specific loci as well as manner of spread of molt from them are identifiable in *Aphelocoma* as racial, specific, or generic characters. Nineteen loci are recognized in the postjuvenal molt of *A. coerulescens*; six additional ones are recognized in the complete molt. Interracial differences in molt loci are few in *A. coerulescens*; more pronounced differences occur in *A. sordida* and *A. unicolor.*

In *A. c. oocleptica,* the period of the postjuvenal molt is about two and one-half months; that of the complete molt is about three months. In interior and southern races of the same species, it is longer.

The postjuvenal molt of *A. unicolor* is less extensive on the wing than that of *A. coerulescens.* The period of the postjuvenal molt is at least three months; that of the complete molt is from three and one-half to five months. Greater intraracial variation in sequence of molt occurs in *A. unicolor* than in the other two species.

In *A. sordida,* molt occurs later and occupies a longer period of time in *A. s. arizonae*

than in races of that species to the south and east. The complete molt of *arizonae* lasts from more than four months to almost six months. Postjuvenal molt of the wing is more variable in *A. sordida* than in the other two species; in extent, it is more or less intermediate between them.

In *A. coerulescens* and *A. sordida,* the first complete molt begins, on the average, before that of birds undergoing later molts; irregularities occur in the first complete molt of all three species more frequently than in either the postjuvenal or subsequent complete molts.

First-year specimens of *Aphelocoma* can be distinguished from adults primarily by differences in shape of rectrices and remiges and in color of retained versus replaced greater wing coverts. Light coloration of the bill in young individuals of *A. sordida* and *A. unicolor* which have passed through the postjuvenal molt does not serve as a criterion in separating age classes. In the former species, light color on the bill may disappear from the ages of slightly less than one year to more than two years. There is a tendency for males to acquire black bills before females. Northeastern populations of *A. sordida,* primarily the race *couchii,* differ from others of the same species in that light coloration of the bill is lost before the postjuvenal molt is completed.

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DRONE BEES SELECTED BY BIRDS

By CHAPMAN GRANT

I have kept a hive of bees on my garage roof in San Diego, California, for three years. Mockingbirds (*Mimus polyglottos*) and Black Phoebes (*Sayornis nigricans*) have lived in the garden and raised their families during this period without molesting the bees. This year I noticed the Mockingbirds standing on the roof and springing into the air to capture bees which they would pound on the roof and finally swallow. A little later on they were carrying away many bees and later still they brought two young and fed them from the roof a few feet from the entrance of the hive. In early July one of the Black Phoebes brought her three grown young and fed them regularly on bees. She would swoop near the hive, snap a bee in midair, and fly to a cornice where she pounded the bee a little and then crammed it down the throat of her ravenous young. This performance took place after the young Mockingbirds had left, but the adult Mockingbirds continued their depredations.

These observations were new to me and accordingly they were related to Mr. Clinton G. Abbott and Mr. Lawrence M. Huey of the San Diego Society of Natural History. Neither had ever heard of Mockingbirds eating bees. Further investigation led me to Mr. Geo. B. Wright, apiarist and for many years a dealer in bee supplies in San Diego. He stated that he had seen Mockingbirds eat bees and had had reports that California Jays (*Aphelocoma californica*) also ate them.

Mr. Fred Hanson, for 27 years bee inspector of San Diego County, stated that he had known that Mockingbirds and Cliff Swallows (*Petrochelidon albifrons*) ate bees. He recalled that only that morning he had inspected 60 stands of bees at the home of Mrs. Ted Hopkins at Ocean Beach, San Diego, and that a flock of swallows was feeding on her bees. I asked Mr. Hanson how it was possible for a tender-mouthed swallow to feed on stinging bees. He replied that possibly they might be feeding on drones and that, contrary to common belief, drones fly about.

I immediately went to Ocean Beach and found a few swallows hawking around the apiary. The next day Mr. L. M. Huey accompanied me. There were probably thirty swallows circling around. We observed them catching the bees, and they always flew immediately thereafter in the same direction, carrying their catch protruding from the mouth. We also noted bees following swallows for short distances. It seemed strange to me that birds as expert as swallows should do so much circling through the flying bees before making a capture. This fact recalled Mr. Hanson's statement that the swallows might be selecting drones from among the multitude of flying workers.

The following day Mr. Huey and I again visited the apiary and saw numerous swallows. Mr. Huey collected seven adults. One had a bee in its mouth, but dropped it when shot and we were unable to locate the bee. We followed the line of flight and found the colony nesting under the eaves of the stucco home of Mrs. I. W. Parks about five city blocks from the apiary. There, we collected 12 young from 3 of the 12 nests. The young were well feathered but still unable to fly. Mrs. Parks had intended to destroy the nests after the young departed because of the vermin with which the nests and birds were infested. The nests were alive with Barn Swallow bugs (*Oeciacus vicarius*) and fleas (*Ceratophyllus gallinulae*) which Mr. Charles Harbison obligingly identified. Mr. Huey found the adults covered with the fleas, which adhered to the host. The trash in the nests contained wriggling flea larvae.

Mrs. Hopkins told us that a Black Phoebe had been in the habit of eating bees, sometimes as many as ten in rapid succession. We saw Mockingbirds eating bees at her apiary, but did not see the phoebe feeding.

Mr. Charles Harbison identified the stomach contents of the 7 adult and 12 young swallows. In the 7 adults he found three drones. Mr. Huey had already removed one drone from the throat of a specimen he prepared. Thus the 7 adults contained 4 drones. One specimen contained a rose-weevil (*Pantomorus godmani*) as identified by Mr. Harbison. "Adults of this beetle do not fly and may be kept off trees by cotton or tanglefoot around the trunks" (Essig and Hoskins, Univ. Calif. Agr. Ext. Service, Circular 87, 1934:42). How then did the swallow capture the rose-weevil? The stomach contents of the 12 young included 12 drones. Five specimens contained one each; two had two each; one had three and three had contents so far digested that identification was not made. The identifications were all from complete drone heads. No part of a worker bee was found. This finding apparently gives the Cliff Swallow a clean bill of health with the apiarist. As to the Mockingbird it would be interesting to determine the class of bee it eats, but inasmuch as it beats them before swallowing I believe that workers as well as drones may be taken.

Mr. Ed. Harrison of Encinitas, California, informs me that from his personal observation he knows that the Cassin Kingbird (*Tyrannus vociferans*), Western Kingbird (*Tyrannus verticalis*), Black Phoebe, and Western Wood Pewee (*Myiochanes richardsonii*) eat bees.

When I was a small boy at my present home in San Diego, there was a large eucalyptus tree in the yard. A pair of Western Kingbirds, "bee martins" to us, nested in this tree. Bees were attracted by the flowers of the tree. Underneath the tree there was almost always to be seen the heads and thoraces, still living and buzzing, of honey bees. I could hear the kingbirds snap their bills, but cannot say that I ever actually saw them snip the abdomen from a bee. I am certain, however, that the mutilated bees under the tree were due to the predation of the bee martins. I feel it safe to assume that flycatchers can handle stinging bees without being hurt, but that birds that catch their prey with the mouth instead of the bill must select stingless drones.

Under date of June 23, 1945, Dr. Alexander Wetmore kindly furnished this observation: "In June, 1911, at Lares, Puerto Rico, Señor Linares, who had a small apiary, reported to me that birds were very active among his bees. I spent parts of two days studying this matter and found that the principal species attracted was the Gray Kingbird, *Tyrannus dominicensis*. I shot a number at this apiary and found domestic bees of the worker group in the stomach of all of them. While some other species were suspected, namely another large flycatcher, *Tolmarchus taylori*, I did not find that they were troubling the bees. The kindbirds were definitely taking workers and not drones by actual stomach examination."

The list of the United States Fish and Wildlife Service of birds that are known to eat bees shows that our observations on the Black Phoebe are unrecorded. The U.S.D.A. Farmer's Bulletin No. 630, revised, 1926, states on pages 23 and 24 that kingbirds eat a great majority of drones. Six hundred and sixty-five stomachs of the Eastern Kingbird (*Tyrannus tyrannus*) were examined and 22 contained 61 honey bees of which 51 were drones and 8 workers; 62 stomachs of the Western Kingbird contained 30 honey bees of which 29 were drones and one a worker. This discrimination makes me believe that a phoebe also probably selects drones, but there is no observational evidence of selection as there was among the swallows. I never saw kingbirds appear to select.

Following is a complete list of birds which are known to eat bees as compiled from the files of the U. S. Fish and Wildlife Service and kindly furnished by Mr. A. L. Nelson, Assistant Chief, Division of Wildlife Research.

		Number of stomachs in which bees were found	Range of number of bees in stomachs
Colymbus grisegena	Red-necked Grebe	2	1
Colymbus auritus	Horned Grebe	5	1–6
Butorides virescens	Green Heron	1	1
Buteo lineatus	Red-shouldered Hawk	1	2
Bonasa umbellus	Ruffed Grouse	2	1
Phasianus colchicus	Ring-necked Pheasant	3	1
Fulica americana	American Coot	1	1
Squatarola squatarola	Black-bellied Plover	5	1–3
Arenaria interpres	Ruddy Turnstone	1	1
Larus philadelphia	Bonaparte Gull	1	1
Geococcyx californianus	California Road-runner	6	1–10
Melanerpes erythrocephalus	Red-headed Woodpecker	1	1
Asyndesmus lewis	Lewis Woodpecker	1	1
Tyrannus tyrannus	Eastern Kingbird	27	1–7
Tyrannus verticalis	Western Kingbird	6	1–12
Myiarchus crinitus	Crested Flycatcher	1	1
Myiochanes virens	Eastern Wood Pewee	2	1
Nuttallornis borealis	Olive-sided Flycatcher	16	1–10
Hirundo erythrogaster	Barn Swallow	1	1
Petrochelidon albifrons	Cliff Swallow	13	1–6
Progne subis	Purple Martin	5	1–3
Cyanocitta stelleri	Steller Jay	3	1
Aphelocoma californica	California Jay	11	1–6
Pica pica	Black-billed Magpie	2	1
Corvus brachyrhynchos	American Crow	4	1–2
Heleodytes brunneicapillus	Cactus Wren	1	3
Mimus polyglottos	Mockingbird	4	1
Dumetella carolinensis	Catbird	1	1
Toxostoma rufum	Brown Thrasher	1	1
Toxostoma redivivum	California Thrasher	1	2
Turdus migratorius	Robin	2	1
Sialia sialis	Eastern Bluebird	1	1
Vireo belli	Bell Vireo	1	1
Vireo olivaceus	Red-eyed Vireo	1	1
Piranga erythromelas	Scarlet Tanager	5	1–12
Hedymeles melanocephalus	Black-headed Grosbeak	1	1
Zonotrichia coronata	Golden-crowned Sparrow	1	2

San Diego, California, July 16, 1945.

NOTES ON THE WINTER BIRD-LIFE OF FAIRBANKS, ALASKA

By GEORGE MIKSCH SUTTON

From February 12 to 18 inclusive and from March 21 to 26 inclusive, 1945, I was stationed near Fairbanks, Alaska, testing survival equipment for the Army Air Forces. While I had little time for ornithology, I nevertheless was on the lookout for birds wherever I went, and kept notes faithfully. During the earlier period I was afield a total of about 40 hours. On five days of the seven I went by motor transport to Cleary Summit, an inconspicuous, smooth-topped mountain with an elevation of slightly more than 2000 feet, about 16 miles (20 some miles by road) northeast of town. Here the mixed spruce, birch, balsam poplar, and aspen woods thinned out considerably at higher elevations, some areas being quite devoid of tree growth or shrubbery. The weather was beautifully clear and cold throughout the seven days, recorded temperatures at the Summit or at Fox (a point about half way between Cleary Summit and Fairbanks) being as low as —38° F. and —42° F. by day and —51° F. by night. The snow, not quite knee deep, had a fair crust in the more exposed places, and was nowhere badly drifted. There was little wind. Birds were scarce. Often I walked for miles without seeing so much as a jay or chickadee. But when I did come upon birds, I often found two or more species in a loose band. I saw several caribou, a few red squirrels, and tracks of snowshoe rabbits, red foxes, and mice in the vicinity of the Summit. On February 17 I motored to Chatanika, a little cluster of dwellings five or so miles north of Cleary Summit.

From March 21 to 26 I was afield from one to four hours daily, a total of about 23 hours. During this period I covered rather thoroughly the north bank of Chena "Slough" from 3 to 8 miles east of Fairbanks. Once I walked directly northward a mile or so across the stream's broad flood-plain, finding the woods there to be rather thin. Some stands of spruce along the slough were fairly dense, but most of the woodland had obviously been cut over, and some areas had been thoroughly cleared. Noticeable among the second growth were aspens, poplars, birches, tamaracks, alder, and wild rose. The snow was about knee deep and nowhere did it have a firm crust. The weather was delightful, with bright sun, very little wind, and temperatures ranging from 50° F. down to about 15° F. The area covered was low in comparison with Cleary Summit, the elevation being from 470 to about 600 feet. Again I encountered few birds and considered myself fortunate if I saw more than two or three chickadees, a grouse or two, some ravens, and a flock of 8-10 redpolls on a six-mile tramp. Judging from my observations I should say that bird-life in general was not more abundant in the low country than in the high country. As for ptarmigan, I saw them more frequently in the vicinity of Cleary Summit than elsewhere.

The following list includes only the species which I recorded personally during the two above-mentioned periods. The few specimens obtained are now at the Museum of Zoology, University of Michigan. For the subspecific determination of these, as well as for a critical reading of the manuscript, I am indebted to Joseph J. Hickey. Olaus J. Murie also was good enough to read the manuscript and to offer suggestions. Identification of the stomach contents of the specimens of Sharp-tailed Grouse and Richardson Owl was checked by A. L. Nelson, Fish and Wildlife Service, U. S. Department of the Interior.

Accipiter gentilis. Goshawk. I noted this species only in the vicinity of Cleary Summit where, on February 13, I observed one chasing a flock of ptarmigan. On February 17 I saw two moving back

and forth swiftly over the shrubbery and stunted spruce trees looking for prey. Occasionally they made their way to the very top of the ridge, where, perched on a stub, they surveyed their surroundings intently.

Canachites canadensis osgoodi. Spruce Grouse. First seen on February 17, about 4 miles east of Fairbanks, when I flushed three birds from rather open, mixed spruce, aspen, and birch woodland a few rods back from a frozen slough; a female was collected. On March 23, at the edge of a pure stand of spruce about 7 miles east of Fairbanks, I came upon a male and female perched a few yards apart in the trees. The female became agitated as I approached, lifted her head and eyed me closely, then put her head down, took a step or two along the branch, elevated and partly spread her tail, and flew off uttering a low *kuk, kuk, kuk* of protest. The male, which remained wholly unperturbed by this alarm, I collected. In the crop and gizzard of the two specimens I found nothing but spruce needles and small, smooth, remarkably uniform pebbles of milky white quartzite. On comparison with a series of *Canachites canadensis canadensis,* Mr. Hickey found the female to be slightly grayer than female birds from Labrador; but the male was like Labrador males save that, owing to the deepness of the black in its plumage, the barring appeared to be sharper.

Bonasa umbellus yukonensis. Ruffed Grouse. Noted several times 4 to 8 miles east of Fairbanks, at about 500 feet elevation, in pure stands of aspen and open mixed woods along Chena Slough. As a rule the birds were in groups of two or three, feeding in the trees or in snowless areas under the largest spruces. The dozen or so individuals which I saw all were definitely gray-tailed. On February 27 I took a male (not fat; testes not enlarged) of this pale gray race about 5 miles east of Fairbanks. The crop and gizzard were filled with alder catkins, willow buds, birch buds and twigs, aspen buds, wild rose hips, and a few cranberries. On March 23, in a dense stand of spruce about 8 miles east of Fairbanks, I found the feathers (no bones whatever) of a Ruffed Grouse scattered in the snow. The rectrices were gray. I encountered no living Ruffed Grouse anywhere in this woods, nor did I succeed in discovering a trace of mammalian footprints near the remains. The only bird of prey seen in that vicinity was a Richardson Owl.

Lagopus lagopus. Willow Ptarmigan. Ptarmigan or their tracks were seen daily from February 12 to 18, principally in the vicinity of Cleary Summit at from 1400 to 2000 feet elevation, but also at lower points along the Steese Highway north of Fox. The birds went about in flocks of 4 to 30 individuals, usually frequenting the sheltered parts of the more open slopes and often pausing for a rest or sunbath at the side of the road. They were in full winter feather, and their silky white plumage had a delicate pink cast. In alighting they often kicked the loose snow about, getting it into their eyes. Goshawks hunted them at Cleary Summit, but we found no remains of ptarmigan which had actually been killed by these hawks. Two females which I examined but had no opportunity to identity subspecifically had eaten quantities of cranberries and willow buds. One of these (February 17) was probably fully adult; the other (February 18) may have been a bird of the year, for it was rather small and the outermost primary and covert of the summer plumage on each wing had apparently failed to molt.

Pedioecetes phasianellus caurus. Sharp-tailed Grouse. I saw the Sharp-tailed Grouse but once—a single female, which I shot from the top of what appeared to be the tallest spruce of the forest about a mile north of Chena Slough and 5 miles east of Fairbanks. The specimen was not fat. Some of the ova were somewhat enlarged. The crop contained 68 alder catkins, most of which were quite whole. The stomach contained the remains of several more alder catkins (20%) as well as more than a hundred wild rose seeds (80%). The eyes were hazel. The subspecies *caurus* was described from the Fairbanks region by Friedmann (Jour. Wash. Acad. Sci., 33, 1943:189). Dr. Friedmann, who has been good enough to compare it with material in the National Museum, states that it "agrees very closely with the type of *caurus,*" and he considers it "a typical example" of that race.

Asio flammeus. Short-eared Owl. On March 25, in the late afternoon, I saw a Short-eared Owl flying back and forth along the brushy edge of the woods bordering Chena Slough about 5 miles east of Fairbanks. I had abundant opportunity to identify it, for I watched it for about ten minutes. It apparently was hunting mice, for it made a point of hovering over patches of grass which protruded from the snow.

Cryptoglaux funerea richardsoni. Richardson Owl. At about noon, March 25, a Richardson Owl was seen by several persons along the road skirting Chena Slough about 6 miles east of Fairbanks. It was about 10 feet from the ground, sitting motionless in the sunlight, with its eyes partly closed. When one of the party approached it, hoping to obtain a photograph, it stared straight downward at the camera, and flew off when the lens was about 5 feet away (see fig. 48). After this incident had been reported to me later that day, I begged to be taken to the spot. With an hour's searching we found a Richardson Owl perched on the top of a birch stub 15 feet from the ground about 200 yards

back from the road, more or less in the direction the flying bird had been seen to take. The specimen proved to be a female, not at all fat, with slightly enlarged ovary. In the stomach were the remains of a rather large mouse, probably *Microtus*, the hind legs and tail of which had not yet been digested.

Picoides tridactylus fasciatus. Three-toed Woodpecker. This species I saw only in mixed woodland along Chena Slough at about 500 feet elevation. It could hardly have been common in the region, for I was constantly on the lookout for it, yet recorded only three individuals during the course of my stay. The first of these, a female, was with four Black-capped Chickadees about 3 miles east of town. It alighted momentarily in an aspen near me, swung deliberately across the highway, and disappeared among some large spruces (March 21). The second was a male, seen by Donald Stullken of my party, again along the highway east of town. It was on a stub only a few feet from the ground (March 21). The third was a female, which I collected along a small brook about 2 miles east of town, on March 22. It was pecking industriously at a slender birch. It was not at all fat and the ovary was

Fig. 48. Richardson Owl, photographed at Fairbanks, Alaska, on March 25, 1945, by A. Bajkov.

not enlarged. Its wing measures slightly less (108 mm.) than the low limit for females (109 mm.) given by Ridgway for *fasciatus*. At no time during my stay did I hear a woodpecker of any sort calling.

Corvus corax. Holarctic Raven. Common about Fairbanks and along Chena Slough; less common, as a rule, at Cleary Summit and in other more remote areas. It has become semi-domesticated because of the abundance of food about the town and military installations. Never did I walk along Chena Slough without seeing literally dozens of these birds. Even in February they appeared to be going about in pairs, and in late March the woods resounded with their curious courtship cries. One call note was a mellow, not unmusical, rapidly given *coo-look, coo-look, coo-look*! At no time did I see them nest building, but some pairs behaved as if they had selected their nest territories. On February 17, between Cleary Summit and Chatanika, I saw a flock of 19 Ravens circling high in the air. I think they had gathered to feed on the remains of a caribou which had been killed a few days previously in that area.

Perisoreus canadensis fumifrons. Canada Jay. Noted several times in the vicinity of Cleary Summit, usually in company with other small birds, at elevations of from 1000 to 1800 feet, February 13 to 18. It was not partial to coniferous woodland there; indeed, I saw it frequently in pure stands of

aspen and birch. It was conspicuous along the Steese Highway on cold mornings, when bands of three to six birds gathered at the edge of the woods to bask in the sun as it rose over the mountains. Now they looked like soft gray balls, with their long, exceedingly fluffy body plumage almost hiding their wings and completely covering their feet. Three specimens were taken at about 1700 feet, south of Cleary Summit, February 14. The ovaries of the two females were not enlarged, but in the male the testes measured about 4 × 6 mm. At Chatanika (about 1000 feet) on February 17, I saw six or seven individuals come to food placed out for them. It was surprising to find the species rare below 1000 feet. Indeed I saw it only twice anywhere in the vicinity of Fairbanks proper. On March 25 I encountered a single bird in a stand of small spruce about 7 miles east of town and a mile or so north of Chena Slough. I think this bird was a female, for its coloration was rather dull. It sang almost continuously in a soft voice as it moved deliberately from tree to tree.

Parus atricapillus turneri. Black-capped Chickadee. Noted at elevations from 470 to 1800 feet, in mixed woodland. Not often seen at Cleary Summit proper, nor anywhere in pure stands of spruce. Commonest along Chena Slough a few miles east of Fairbanks, where it was conspicuously more dirty than in areas well back from the town and railroad. Usually I encountered it in bands of three or four. On a walk of 3 to 8 miles I might come upon two or three such bands. A male and female taken on February 14 about a mile south of Cleary Summit were so clean they did not have to be washed. Neither specimen was fat and the sex organs were only slightly, if at all, enlarged.

Parus hudsonicus. Brown-headed Chickadee. Noted only at lower elevations (460 to 600 feet), as a rule in pure stands of spruce. I never saw more than three individuals at a time, nor more than nine individuals in one day. It was not seen at all in the vicinity of Cleary Summit. I took three specimens (female, February 16; female, March 23; male, March 25) along Chena Slough, finding the ovaries in the females to be unenlarged and the testes of the male to measure only 2 × 2 mm. In Mr. Hickey's opinion these birds are too gray-capped for *P. h. hudsonicus*, which supposedly is the race of interior Alaska. All three specimens were thoroughly washed, so final determination may have to await the collecting of strictly comparable material.

Pinicola enucleator alascensis. Pine Grosbeak. Noted on February 13, 14, and 18 and on March 22, 24, and 25, usually in flocks of 4 to 10 individuals. A single male seen on March 22 was singing brilliantly. Not noted at Cleary Summit proper, but seen at various elevations up to 1800 feet. Observed to feed on weed seeds and rose hips (February 13), grain scattered along the road (February 14), and spruce and tamarack seeds (March 22 and 24). A flock of about 30 which I observed along Chena Slough on March 24 appeared to be composed wholly of female birds, but some of them probably were young males. All were calling in musical tones. In the three specimens taken (male, February 18; male, March 22; female, March 24) the gonads were unenlarged.

Loxia curvirostra. Red Crossbill. I saw a flock of about a hundred Red Crossbills in a spruce wood below Cleary Summit, at about 1700 feet, on February 13.

Acanthis flammea flammea. Common Redpoll. Noted daily at all elevations and in all sorts of woodland. Equally common on Cleary Summit and along Chena Slough. From 10 to 70 birds were seen or heard each day. They often were noted high in the air, swinging from one feeding ground to another. Flocks were noisy, restless, and surprisingly wary. They were most approachable when, intent on feeding on the bare ground under the spruces or on slopes with southern exposure, they shoved and burrowed their way through the loose debris and dry leaves. The only Redpoll I collected was a male taken about 2 miles east of Fairbanks on March 22. It was by itself, scratching among leaves on a bank. It was not fat and its testes were not enlarged.

Plectrophenax nivalis. Snow Bunting. Noted only once: a flock of about 30 males, 2 miles east of Fairbanks, March 21. A familiar chirp called my attention to the birds, which were perched in the top of a tamarack tree as motionless as so many cones. As I approached, some of them hopped about and called sharply, and the whole flock bounded away, alighting a quarter of a mile off in a field which was partly free of snow.

Army Air Forces Center, Orlando, Florida, July 2, 1945.

FROM FIELD AND STUDY

Rose-breasted Grosbeak in Los Angeles County, California.—On Sunday, June 3, 1945, while visiting a mountain ranch in the vicinity of Vincent, Los Angeles County, California, my attention was called to a bird feeding in a black mulberry tree (*Morus nigra*). Examination with a 5× field glass at a distance of 25 feet revealed a male Rose-breasted Grosbeak (*Hedymeles ludovicianus*). The red V-shaped patch on the breast was plainly visible.

This individual was the only one observed that day, but residents of the area stated they had seen this bird or others of the same species on previous occasions throughout the spring in various parts of the canyon. The bird did not sing while it was under observation and I was unable to attribute any call notes to this species.—ARTHUR L. BERRY, *Alhambra, California, June 11, 1945.*

Another Nighthawk Migration on an Arizona Desert.—In the November issue of The Condor for 1941 we reported (p. 293) on "A Nighthawk Migration on an Arizona Desert" noted on July 29, 1941. On August 17, 1943, in the same general area, we observed a flight which so overshadows the former observation that it should be recorded. Driving west on Highway 66 from Flagstaff toward Williams, about 7 p.m., we saw several groups of Nighthawks (*Chordeiles minor*) between Bellemont and Grand Canyon Junction. The first two of five groups numbered twelve each, and the total count amounted to 43 seen in about 15 miles driving at 35 miles per hour.

On reaching Grand Canyon Junction and turning north, nighthawks were streaming across the road by the hundreds, flying from 50-75 feet above ground and in a southwest direction. We stopped the car and began counting the bird crossing about one-eighth of a mile of the highway where visibility was good against a cloudy sky. The counts by numbers were as follows:

7:35 p.m.,	56	7:39 p.m.,	27
7:36	67	7:40	13
7:37	33	7:41	29
7:38	57	7:42	5

Thus, in eight minutes, 287 had been counted.

Proceeding toward Grand Canyon, we could see a stream of Nighthawks following down a little valley to the east and then across the road behind us where we had made the count. The next few miles netted about two to six birds seen per mile near the road until, after sunset, visibility became poor. Total Nighthawks seen between Bellemont and the T.W.A. airport (approximately 46 miles) amounted to 412.—HAROLD C. BRYANT and AMY M. BRYANT, *Grand Canyon, Arizona, June 25, 1945.*

A Harris Sparrow at Santa Barbara, California.—On March 20 of this year, an immature Harris Sparrow (*Zonotrichia querula*) was taken in a two-celled Potter trap at our home at 165 Foothill Road, Santa Barbara, California. When it was discovered, no other birds were near the trap. Golden-crowned Sparrows and White-crowned Sparrows, which are reported as its common associates by Grinnell and Miller in "The Distribution of the Birds of California," were frequently seen and trapped during March. The nearest occurrences of the Harris Sparrow to the Santa Barbara region as reported in the above-mentioned volume are one at Pasadena, April 25, 1937 (Michener and Michener, Condor, 40, 1938:39) and one at the San Gabriel River Sanctuary near Los Angeles, March 27 to April 25, 1943 (Comby, Condor, 45, 1943:199).

The identification of the bird was confirmed by Mr. Egmont Rett of the Santa Barbara Museum of Natural History, who said that within his knowledge it was the first of the species to be reported in this vicinity. For that reason he asked that the bird be added to the Museum collection where it now is no. 3886.—MARY M. ERICKSON, *Santa Barbara College, University of California, August 30, 1945.*

The Earliest Name for the San Francisco Brown Towhee.—On a previous occasion (Auk, 59, 1942:449-450), I stated that Bonaparte's type of *Oriturus wrangeli* belonged definitely with the central coast race of the Brown Towhee currently known as *Pipilo fuscus petulans* Grinnell and Swarth. In their recent work, "The Distribution of the Birds of California" (Pac. Coast Avif. No. 27, 1944:479), Grinnell and Miller continue to use the name *petulans* on the basis that I had given no supporting evidence in regard to *wrangeli*. More properly, the conservative action is that of Miller since my note appeared after the death of Grinnell. Details concerning the type are given in the following paragraphs.

Bonaparte's type of *Oriturus wrangeli* is (or was in July, 1939) in the Rijksmuseum van Natuurlijke Historie at Leiden. It is a mounted bird, perched on a small bar stand, and is in good condition

although undoubtedly somewhat reddened by post-mortem "foxing." The plumage is fresh save that the tail feathers show a slight amount of abrasion and it is reasonable to conjecture that it was collected in early winter. A very old and faded, hand-written ticket on the upright of the stand reads "Pyrgita Brand [*sic*] / Fringilla Wrangelli [*sic*] / Brand [*sic*] Sp. nov / Russie." At some subsequent date "Russi america" has been added, and still more recently Dr. Junge (Director of the Museum) has written in pencil the word "Type." On the bottom of the stand is written "Pyrgita? Brandt / Fringilla Wrangelli [*sic*] / Brand [*sic*] sp. nov. / Russie." The word "Wrangelli" has been lined through and "fuscus" written below. There is no indication of sex other than that provided by the bird itself. There is no catalogue number.

This type is somewhat redder (as a result of foxing, probably) than three other Bay region specimens in the Leiden Museum. It is not, nor in my judgment ever could have been, colored like the darker and grayer *crissalis* and *carolae*, of which there were three and one specimens, respectively, available also. Further evidence in support of this belief is found in the description of this specimen by Hartlaub, written ninety years ago (Jour. für Ornith., 3, 1855:361-362), wherein he describes a reddish brown, not a grayish brown bird. In regard to the measurements given by Hartlaub, it would seem that he used the English or Rhineland foot rather than the Pied du Roi which he usually employed.

Further, the type has the normally longer bill with straighter (less convex) lateral profile, and longer tarsi of the central coast race as compared with *crissalis*. The general size and particularly the bill rule out any association with *carolae*, aside, of course, from color considerations. Measurements of the type which, in so far as size is a criterion, is a female, are as follows: both wings (unflattened), 88 millimeters; tail (from insertion of the central pair of rectrices), 103; culmen (from edge of skin across ridge, to tip), 15.0; depth of bill (from edge of skin on mandibular ramus to edge of skin on ridge of culmen), 10.0; tarsus, 29.4; middle toe minus claw (not properly measurable because flexed around perch), 17+.

To repeat the previous determination, the name of *Oriturus wrangeli* is to be associated with the race of central coastal California since structural as well as color characters so identify the type. The citation for this earliest name for the San Francisco Brown Towhee, *Pipilo fuscus wrangeli* "Brandt" (Bonaparte), together with other comment concerning it may be found in the Auk as above cited.—A. J. VAN ROSSEM, *Dickey Collections, University of California, Los Angeles, September 20, 1945.*

A Second Specimen of the Eastern Pileolated Warbler Taken in Oregon.—On the morning of December 6, 1944, W. H. Crowell, former President of the Oregon Audubon Society, found a dead warbler on the lawn at his residence in the west Portland hills district, Oregon. The writer was out of town at the time, so Mr. Crowell laid the bird away in his refrigerator until I returned on December 21, when it was presented to me. It proved to be an immature Eastern Pileolated Warbler (*Wilsonia pusilla pusilla*) in first fall plumage. This identification was verified by Dr. John W. Aldrich. The only other record of the occurrence of this bird in Oregon is a specimen (Jewett Coll. no. 685) taken by the writer on December 11, 1908, on Government Island in the Columbia River ten miles east of Portland, Oregon (Birds of Oregon, 1940:515).—STANLEY G. JEWETT, *Portland, Oregon, June 30, 1945.*

Snail-eating by the California Jay.—In June of this year a California Jay (*Aphelocoma californica*) was observed at a distance of eight feet searching the main stem of a small bush of the cultivated plant *Ochna floribunda*. The bird's activity around a plant that would not be expected to yield fruit and its plucking away of dead and withered leaf clusters along the main stem led to more than casual observation. It was a surprise to see it locate and capture a common introduced garden snail, *Helix aspersa*, then hop to a fence rail and commence hammering at and breaking through the side of the snail's shell. Even with this evidence of gustatory interest, it did not occur to me that I was watching more than a display of curiosity and "play" until the bird began eating the contents of the shell.

On speaking of this interesting discovery to my family, I was surprised and chagrined to discover that they had observed the occurrence on several occasions, but they had not thought it worth mentioning.—R. B. COWLES, *University of California, Los Angeles, September 8, 1945.*

More Records of the Chat in Marin County, California.—We have previously reported in The Condor the trapping and banding of two specimens of the Chat (*Icteria virens*) at our residence in Manor, Marin County, California. The first specimen was taken on August 15, 1934, and the second specimen was taken on September 29, 1943. Additionally, we obtained a mid-summer

sight record of this species, also at Manor, in July, 1942. Except for these three instances we have consistently failed to note any other occurrence of the Chat in Marin County during twenty years of residence and extensive field work there, until the spring of 1944.

We have spent considerable time each spring and summer in trapping a number of different species of birds normally breeding along Manor Creek, which is a small water course paralleling the old, abandoned Northwestern Pacific Railroad right-of-way, close to where Manor Station was formerly located. This creek is one-half mile distant from our home, although a smaller tributary running through our grounds joins the main course midway between Manor and Fairfax.

On the morning of April 23, 1944, we heard a Chat call for the first time along Manor Creek. We had trapped that locality all of the two preceding days and did not see or hear anything that would indicate that this bird arrived earlier than the morning we first heard it sing. We were successful in trapping it a short time later and it proved to be a male, although it showed no external indications of being in a breeding condition.

On subsequent week-ends we trapped the same territory and had about concluded that the previous capture was a casual stray, when late on May 26, I again heard a Chat calling from the same locality in the creek bed. This bird was trapped the following morning, and it also was a male and was in high breeding condition. May 27 and 28 were spent covering the full length of the creek, but no other Chats were found or heard.

On June 10, a resident of Manor, whose property abuts Manor Creek, called my attention to still a third Chat, which was singing in exactly the same section of the creek bed at which we had previously taken the two birds. This man stated that, although he had lived in his present home for many years, he had only heard the characteristic song of this species during the previous two days—and nights! He complained that the bird's loud song kept him awake, and he threatened to shoot it!

We immediately checked with other property owners on the creek, and almost all of them had heard the Chat sing on either one or both of the preceding nights, and all were positive that they never before had heard or seen a Chat during the varying years of their residence in Manor. This tended to confirm an opinion we held at the time, namely, that the Chats we had caught were casual migrants and were not representative of any range extension by the species.

After trapping this third Chat, another male, the following morning, a further and more careful search was made for additional individuals, and we found what we thought was a female about two-thirds of a mile up the creek. We were unsuccessful in several attempts to trap this particular bird and it disappeared a few days later. Notwithstanding a weekly check of the locality, continued until late fall, we were unable to locate any other Chats during the balance of 1944.

It was determined not to record the foregoing captures other than in the usual bird-banding reports until we might learn whether or not additional Chats would again appear along Manor Creek in the succeeding year.

Starting in mid-April, 1945, a careful watch was maintained for possible new arrivals. It became my practice to walk the length of the creek over the old paralleling railroad right-of-way in the morning, prior to leaving for my office, and again in the early evening upon my return to Manor. No Chats were seen or heard this year until May 6. We had trapped in the area all of the preceding day and no Chats were discovered, yet on the following morning at six o'clock a male was rapturously performing his "dropping" song to a female, for all the world as if the pair had been at home in that creek bottom for many, many days. They, too, were trapped and banded and placed in one of our aviaries at home. We rather anticipated that other Chats would shortly follow, particularly with the territory again being open through the trapping and removal of the first pair, but no further Chats have put in an appearance, and it is now beyond the date on which we took our last Chat in 1943.

The capture of a breeding pair this year may be indicative that we were wrong in assuming that the Chats recently seen or taken in Marin County were, in fact, casual strays. To the contrary, this species may actually be expanding beyond the previously indicated limits of its breeding range, forced by the necessity of finding new nesting areas to replace those recently occupied or destroyd by wartime activities such as extensive military training camps, expanding manufacturing and industrial facilities, Government housing projects, etc. We know of large numbers of riparian locations in the great central valleys of California and also in the Coast districts which have been taken over for military or war industry purposes during the last few years and which provided the specialized environmental niches which "Icterian" preference dictates.

Is it therefore unreasonable to surmise that Marin County, heretofore off the beaten track for Chats, may become a regular, if but sparsely occupied, breeding ground for this most interesting species of warbler?—ERIC CAMPBELL KINSEY, *Manor, Marin County, California, June 12, 1945.*

NOTES AND NEWS

Partial report from the annual business meeting of the American Ornithologists' Union in Boston, October 24, 1945, reveals the election of Hoyes Lloyd, president, and Robert C. Murphy and Josselyn Van Tyne, vice-presidents. Jean M. Linsdale was elected a fellow of the Union.

The annual index for the Condor for 1945 was prepared by Robert W. Storer. We are greatly indebted to him for this important aid.

A significant item in the literature on western birds is J. A. Munro's report on "The Birds of the Cariboo Parklands, British Columbia" (Canadian Jour. Research, D, 23:17-103, June, 1945). Two hundred and twelve species are reported from the region. Much life history information is recorded and habitats are well classified and described. Emphasis is placed on the importance of the area for nesting water fowl.—A.H.M.

PUBLICATIONS REVIEWED

"The Transverse Volcanic Biotic Province of Central Mexico and Its Relationships to Adjacent Provinces" by Robert T. Moore (Trans. San Diego Soc. Nat. Hist., 10, 1945:217-236) deals with faunal problems of the southern end of the central plateau of Mexico in the light of evidence provided by birds. The region is a volcanic belt, the Sierra de Anáhuac, which is four hundred miles long and sixty wide. The author has made a provisional survey of the Mexican avifauna, and the present paper is a more detailed study of the birds of one province and its neighbors. Special attention was given to the Transverse Volcanic Biotic Province because of the abundant material from that region in Mr. Moore's collection. "Approximately 15,000 specimens [were] collected during the past eleven years" by C. C. Lamb, W. W. Brown, and the Mexican collectors, Avilé and Roveglia. An additional ten thousand were taken by Lamb in neighboring provinces. Such a large collection presents endless opportunities, the adequate realization of which will demand the attention of many investigators.

From available evidence, at least eighty species and races are confined to the Transverse Volcanic Province. Some of these are confined to specific subdivisions, or faunal districts. Data are organized effectively in a series of tables. Comparisons are made with five other provinces—Sinaloa, Sierra Madre Occidental, Chihuahua Desert, Sierra Madre Oriental, and Sierra Madre del Sur. A map is provided. This paper is offered by the author "merely as a preliminary effort to stimulate future research in the provinces and biotic districts of Mexico" and limits itself almost entirely to a presentation of facts. No reference is made to Dice's "Biotic Provinces of North America" (see Condor, 45, 1943:203).

Growing interest in the biogeography of Mexico well justifies the publication of this preliminary, but worthwhile paper. Its function seems to me correctly stated by the author. The reader is informed that Major E. A. Goldman and the author have written a paper on "The Biotic Provinces of Mexico," which is now in press.—FRANK A. PITELKA.

MINUTES OF COOPER CLUB MEETINGS

SOUTHERN DIVISION

JUNE.—The regular monthly meeting of the Southern Division of the Cooper Ornithological Club was called to order on June 24, 1945, at 8:00 p.m. by President Walter W. Bennett in Room 145, Allan Hancock Foundation, University of Southern California, Los Angeles, California. It was moved, seconded and carried that July and August meetings be omitted. The secretary was instructed to notify the members.

Mr. Willett read a letter from Frank Pitelka of the Northern Division requesting confirmation and additional information on the newspaper story of a hummingbird maintaining two nests near a home in San Marino.

A short discussion was held regarding the behavior of falcons and buteonine hawks when engaged in conflict over territory.

Dr. Hildegard Howard spoke on the "Evolution of Birds," illustrating her talk with slides showing steps in the development of the modern bird from the earliest specialized reptiles.

Adjourned.—ARTHUR L. BERRY, *Acting Secretary*.

SEPTEMBER.—The regular monthly meeting of the Southern Division of the Cooper Ornithological Club was called to order on September 25, 1945, at 8:00 p.m. by President Walter W. Bennett, Room 145, Allan Hancock Foundation, University of Southern California, Los Angeles, California, with 150 members and guests present. Minutes of the previous meeting were read and approved. The following names were proposed for membership: John Yrizarry, 1141 Carroll St.,

Brooklyn 25, N.Y., by Clinton G. Abbott; Irene F. Jorae, 708 S. College St., Mt. Pleasant, Mich., by Arthur A. Allen; Lt. Henry Kritzler, Altitude Training Section, Walla Walla Air Field, Wash., by Pierce Brodkorb; S. Kent Carnie, 1249 Latham St., Mountain View, Calif., Lincoln van de Griendt, P. O. Box 291, Los Altos, Calif., and William B. Kurtz, 595 El Monte Rd., Los Altos, Calif., by Harold M. Hill; Maleta M. Wernicke, Gull Point, Fla., by E. J. Koestner; Harold Kenneth Nichols, Jr., 710 N. "I" St., Tacoma 3, Wash., by Alden H. Miller; Robert F. Backus, Box 27, Florence, Fremont County, Colorado, Hervey Groff Brackbill, 4608 Springdale Ave., Baltimore 7, Md., Lee J. Burland, 138½ River St., Oneonta, N.Y., George William Cottrell, Jr., 70 Lake View Ave., Cambridge 38, Mass., Elizabeth T. French, 1801 Las Lomas, Albuquerque, N.M., Ray J. Glover, R. D. 1, Addison, Pa., Francis Lee Jaques, 610 W. 116 St., New York 27, N.Y., Hank Van Laar, Ph.M 3/c, Naval Medical School, National Naval Medical Center, Bethesda 14, Md., William Baxter McIntosh, 414 Oakridge Blvd., Lynchburg, Va., Dorothy Mierow, Graduate House, Mills College, Oakland, Calif., Henry M. Parker, 122 School St., Concord, N.H., Robert Charles Ritchie, 250 Riverside Dr., Toronto, Ontario, Canada, Edith L. St. Cyr, Rt. #1, Box 105-C, Fallon, Nev., Edward Lincoln Seeber, 1854-A Kenmore Ave., Buffalo, N.Y., Archie D. Shaftesbury, Professor of Zoology, Woman's College of the Univ. of N.C., Greensboro, N.C., and Robert James Watson, Box 75, Blacksburg, Va., by John McB. Robertson; Caroline W. B. Atkinson, 106 S. La Senda Ave., Three Arch Bay, So. Laguna, Calif., Bernard Wm. Baker, Rural Route #1, Marne, Mich., Cecil Billington, 21060 Thirteen Mile Rd., Birmingham, Mich., Henry Birkeland, Roland, Iowa, Forest Wendell Buchanan, Amsterdam, Ohio, Charles Edward Chamberlin, San Marcos, Texas, Gerald John Chatterton, 549 Edgewood Rd., San Mateo, Calif., Mrs. Edwin O. Clarkson, Wing Haven, 248 Ridgewood Ave., Charlotte, N.C., Miss Marion Clow, P. O. Box 163, Lake Forest, Ill., Russell Thompson Congdon, M.D., Medical Arts Bldg., Wenatchee, Wash., Edmund R. Cross, 1751 University Ave., San Diego 3, Calif., James W. Cunningham, 3009 E. 19th Terrace, Kansas City, Mo., Wendell O. Dahlberg, 11312 S. Michigan Ave., Chicago 28, Ill., Thomas C. Desmond, Box 670, Newburgh, N.Y., Murl Deusing, 142 N. 75 St., Milwaukee 3, Wis., Virginia S. Eifert, Illinois State Museum, Springfield, Ill., Dr. Pennoyer Francis English, Professor of Wildlife Management, Dept. of Zoology, Pennsylvania State College, State College, Pa., Earl Pershing Floyd, 107 S.E. 2nd St., Pryor, Okla., Robert Theodore Gammell, M.D., Kenmare, N.D., Christian S. Goetz, 3503 Middleton Ave., Cincinnati 20, Ohio, Robert Martin Goslin, 316 Wilson Ave., Columbus 5, Ohio, Mrs. Jack Hagar, Rockport, Texas, Roy Cline Hallman, P. O. Box 826, Panama City, Fla., Mrs. Martin G. Hansler, 7348 Paxton Ave., Chicago 49, Ill., Marian Gardner Harlow, 1555 Altivo Way, Los Angeles 27, Calif., Frank Alexander Hartmen, Hamilton Hall, Ohio State University, Columbus, Ohio, Frederick V. Hebard, 612 W. Hartwell Lane, Chestnut Hill, Philadelphia 18, Pa., Harold Martin Hefley, Dept. of Zoology, Texas Technological College, Lubbock, Texas, Herbert Oliver Hill, 61 Irving Pl., New York 3, N.Y., J. Southgate H. Hoyt, 820 W. 3rd St., Williamsport 15, Pa., Walter Wemyss Hughes, Embro, Ontario, Canada, Robert A. Johnson, State Teachers' College, Oneonta, N.Y., Richard Thomas Keller, 717 S. 16th St., St. Joseph 36, Mo., Francis H. Kortright, 5 St. Edmund's Dr., Toronto, Canada, William Ralph Lodge, Silver Lake Estates, Rt. 3, Box 1, Cuyahoga Falls, Ohio, Horace Gordon Mack, care of Gilson Mfg. Co., Ltd., Guelph, Ontario, Canada, Heinz Karl Meng, 116 Miller St., Ithaca, N.Y., Homer Noble Metcalf, Box 175, Harvey, Ill., Merriam Lee Miles, Box 709, Vicksburg, Miss., Jeanne E. Moore, 718 Onondaga, Ann Arbor, Mich., Edmund W. Mudge, Jr., 4105 Averill Way, Preston Hollow, Dallas 5, Texas, Dean Roberts Parker, Biology Dept., Texas Technological College, Lubbock, Texas, Robert Allen Pierce, Nashua, Iowa, Carl D. Riggs, Dept. of Zoology, University of Michigan, Ann Arbor, Mich., Harry G. Rising, 1128 W. 39th, Los Angeles 37, Calif., Clayton Glass Rudd, 315 Medical Arts Bldg., Minneapolis 2, Minn., Evan V. Sage, Rural Rt. 3, Waterloo, Iowa, William G. Schumm, 302 "C" St., LaPorte, Indiana, Mrs. William Simmons, 2007 N. Holton St., Milwaukee 12, Wis., Arthur Eugene Staebler, U.S. Quarantine Station, P. O. Drawer 1246, Miami Beach 39, Fla., Earnest William Steffen, 1000 Maplewood Dr., Cedar Rapids, Iowa, Horace Godwin Stevenson, Jr., 7318 Bryan St., Mt. Airy, Philadelphia, Pa., Elmer William Strehlow, 721 W. Mason St., Green Bay, Wis., Clarence Archer Tryon, Jr., Dept. of Zoology and Entomology, Montana State College, Bozeman, Montana, John Henry Wampole, Broken Bow, Neb., Courtland Y. White, Birchrunville, Pa., Nathaniel Ruggles Whitney, Jr., 975 Willow Ave., Glendale, Ohio, Lt. Rowland S. Wilson, Executive Office, Navy 163, F.P.O. San Francisco, Calif., and Barbara Woodward, LeRoy, N.Y., by W. Lee Chambers.

A motion was made by J. R. Pemberton, duly seconded and carried, that a committee be appointed to memorialize the death of George Willett and that a copy of the resolution be sent to Mrs. Willett and be included in the minutes.

Ed Harrison, by request, again showed his colored motion picture, "The Cruise of the Kingajou."

Adjourned.—DOROTHY E. GRONER, *Secretary*.

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